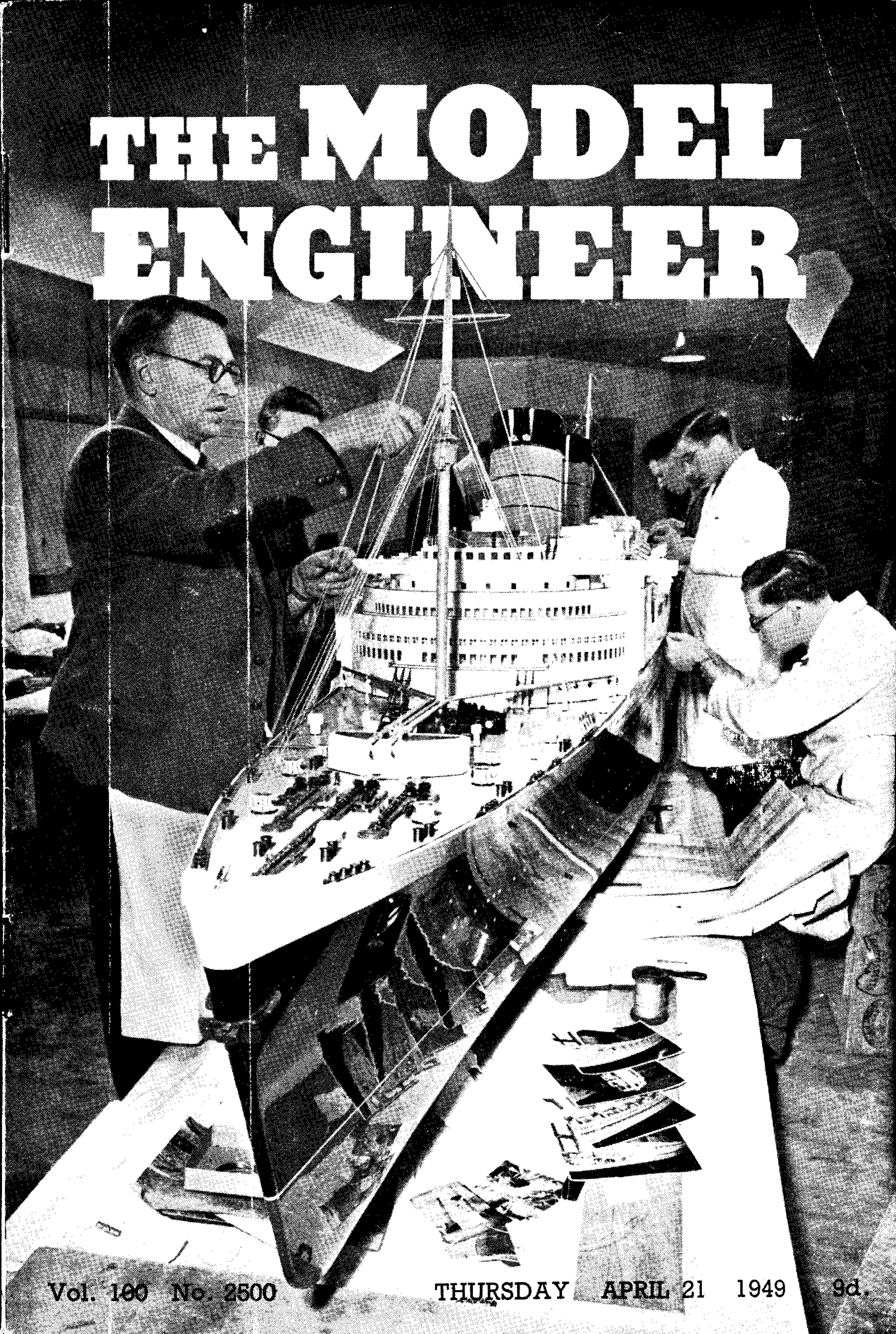
THE MODEL ENGINEER



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The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, *GREAT QUEEN ST., LONDON, W.C.2*

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SMOKE RINGS

Our Cover Picture

● THIS WEEK'S illustration is from a photograph of the large model of *R.M.S. Queen Elizabeth* recently completed by Messrs. Bassett-Lowke, a fuller description of which will be found in our pages this week. When the photograph was taken, the men were busy putting on finishing touches at various parts of the model. The number of man-hours spent in making the model totalled 6,900 which, considering the amount of work involved in making such a magnificent model, speaks well for the efficiency and keenness of the men who made it. The reflections on the starboard bow give some indication of the degree of finish obtained in painting the model.

No. 2,500

● THIS ISSUE scores, as it were, another quincentenial for THE MODEL ENGINEER. We hope we may be excused if we feel proud of the fact. On the occasion of the publication of the 2,000th issue, on September 7th, 1939, a devastating war had broken out, and the results are too well known to need any further notice here. But the "M.E.", as it is affectionately called all over the world, is still going strong, and it is with a feeling of confident optimism that we look forward to the future. We are not yet out of the difficulties that were created as a result of the war; but the demand for THE MODEL ENGINEER is as great as ever, and this is, of course, a sure indication that the magazine is fulfilling its purpose. Our endeavours are, and always will be, applied to maintaining and developing the cordial relations which exist between our contributors, readers, advertisers and ourselves. That was always the chief concern of our late founder, Percival Marshall, whom we are privileged to succeed.

"M.E." Exhibition Judges

● THE JUDGING of the entries in the various classes at the "M.E." Exhibition is always a formidable task that requires men of wide experience and expert knowledge, each in his own particular sphere. Five panels of three are required, and they will be formed from various combinations of the following twelve volunteers: Lt.-Col. J. H. Craine, R.N.R. (Ret.); George Dow, Press Relations Officer, British Railways, Easten Region; W. J. Bassett-Lowke, M.I.Loco.E.; G. P. Keen, A.I.Loco.E.; Ian Bradley; John Latta, *ex*-Chairman, S.M.E.E.; A. F. Houlberg, A.F.R.Ae.S.; D. A. Gordon; E. F. H. Cosh; E. Bowness; E. T. Westbury, and J. N. Maskelyne, A.I.Loco.E. as leader.

What Makes Us Tick ?

● DISCIPLES OF Freud tell us that the force which impels human beings to build miniature replicas of the things they see around them is part of a fundamental striving for creative self-expression. This may not be recognised by the average model engineer happily treadling away at the lathe in his back-room workshop ; and if you asked him why he spent his leisure time in this particular pursuit, being a model engineer and, therefore, of infinite patience, instead of telling you to mind your own business he would probably say quite simply that he enjoyed doing it. If you asked him why he enjoyed doing it, his answer would probably demonstrate that it is really quite wrong to use the word " infinite " to describe anyone's patience—even a model engineer's.

However, there is no doubt that the pleasure we derive from model-making is something which we share with mankind all the world over. A tour of the museums will show that no nation is without its craftsmen and model-makers ; often models are built in spite of the most difficult circumstances and lack of facilities.

As an illustration of the foregoing theory, we publish this week a picture of a Swahili boy with the model boat he has made, using the fruit of the Boab tree for the hull. We cannot help wondering what crude tools he may have used so neatly to hollow out the hull, to fashion and fix the thwart and keel.

The young boat builder

Dredging with Ploughing Engines

● OUR RECENT note with reference to the use of a pair of ploughing engines for dredging part of Southampton Harbour has brought us several letters from interested readers. It would seem, however, that this use of ploughing engines is not so novel as our paragraph might suggest. The Rev. R. C. Stebbing mentions such tackle working on the Wye below Monmouth ten years ago, and he points out that the engines seen in the photograph on page 466 of the " M.E." for April 29th, 1948, are specially adapted for this work. He also mentions that last August he found, at the same location on the Wye, a pair of modern compounds which had had the tops of their boilers cut off and vertical diesel engines fitted, apparently to drive the second motion shaft through bevels.

Mr. M. V. Pink recalls seeing a pair of engines engaged on dredging work near Rye, Sussex, in 1938, and wonders if other readers have some knowledge of these engines, since this work in the area is now done by oil-driven dredgers.

Other readers have seen the engines working at Southampton, and Mr. D. R. Smith, of Bourne End, Bucks, mentions a set employed, in 1946, for dredging the Marine Lake at Southport.

Why Not the Professional Touch?

Reflections inspired by Bassett-Lowke's model of R.M.S. "Queen Elizabeth"

WITH reference to the "Smoke Ring" in our issue for February 3rd about the ¼-in. scale model of the Cunard White Star liner *Queen Elizabeth*, recently shipped to New York by Bassett-Lowke Ltd. of Northampton, we have now received from them a very interesting series of photographs showing the model at various stages of its building. They are all very interesting and of the greatest possible value to ship modellers. We would like to reproduce the entire series, but space forbids, and we must make a selection.

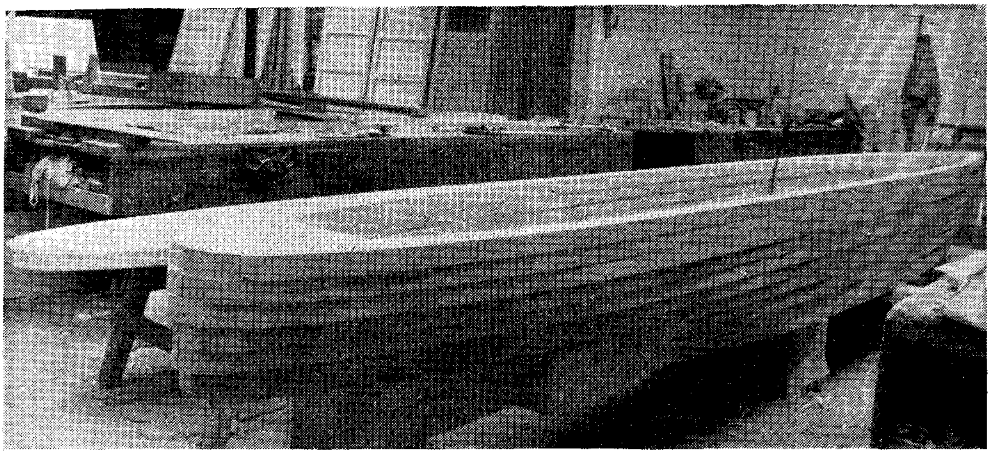


Photo No. 1. Early stages, with the laminations glued and screwed together. Note material left for propeller bosses

The finished model is 21 ft. 7 in. long overall by 2 ft. 7 in. beam and weighs 1 ton 7 cwt. It was made from drawings supplied by the builders Messrs. John Brown & Co. Ltd., of Clydebank. In building a ship, numerous modifications are inevitable as the work proceeds and usually these modifications are indicated on the drawings so as to keep an accurate record of the ship as built. Owing to the fact that the *Queen Elizabeth* was completed during the war years, the final corrections of the drawings were not possible, and, therefore, to make the model an accurate reproduction of the ship every item had to be checked, sketches made, and innumerable photographs taken from which to do the actual work. It can, therefore, be claimed that the model represents accurately all the external details of the ship. It is, of course, purely an exhibition model and has no internal power plant. The whole of the work was carried out by Messrs. Bassett-Lowke's woodworkers, engineers, brass finishers, and painters, under the supervision of the Works Manager, Mr. P. F. Claydon.

The case is of mahogany with a bronze frame and contains 250 sq. ft. of plate-glass ¼ in. thick. The complete case weighs 2 tons. It was made by Messrs. A. Glen & Sons of Northampton.

We have been permitted to see the model at various times during its construction and what strikes us more particularly is the fact that, in a model such as this, the methods employed in the various processes are, of necessity, very similar to those employed by the amateur in building a smaller model. There are, of course, the special problems associated with handling a model of such a colossal size, but on the other hand, in a "one off" job such as this, repetition work and mass production methods are impossible, except in such matters as rail stanchions, lifeboats and similar fittings which present the same problems whatever the scale.

This to us is the great lesson of the model for the amateur. We are too much inclined to look at a model such as this and say to ourselves: "This is all very well for a firm like Bassett-Lowke. They have a large works fitted with every possible labour-saving machine. They have an elaborate paint shop with spray guns and all the latest equipment. They have specialists in the various crafts, and thus their standard is bound to be beyond the reach of the amateur." But is it not the pride of the modelmaker that he is skilled in all crafts, that he is an all-round man and not confined to one craft? The amateur need not be tied to a time schedule, nor does he need to consider the commercial aspect

as does a firm like Bassett-Lowke. He can spend unlimited time on his work, and if what he produces fails to reach the required standard, he can scrap his work and start again.

But to get back to our model. Yellow pine being unobtainable, a baulk of Obeche or African White Mahogany was obtained. The log was 25 ft. long with a diameter at the base of 5 ft. and before cutting weighed more than 6 tons. It was seasoned in the kiln, the time required being 56 days, and the amount of water extracted during the process was 110 gallons. The model was built on the bread and butter system and to reduce the tendency to warp, when assembling the layers, the alternate planks were turned upside down. The propeller bosses were carved from the solid, allowance for them being made when sawing the planks to shape, as will be seen from Photograph No. 1. Bassett-Lowke consider that to insert the bosses is never satisfactory. Similarly with the bulwarks. These also are cut from the solid as may be seen around the stern in Photograph No. 4, and at the bows in our cover picture. After the exterior form has been carved to the correct shape as in Photograph No. 3, the inside is cut down to the deck level leaving the thickness of the bulwarks which receives the rail stanchions. Photograph No. 2 shows the interior cut away for lightness and gives one an idea of the amount of work involved in reducing the hull to its final shape. Actually, this work took 1,100 man/hours and the weight of the hull when carved was one ton. Over 2,000 screws were used for securing the different layers together, which, of course, were glued as they were assembled.

The decks and superstructure were built of plywood of various thicknesses. This work will be seen in progress in Photograph No. 4.

Masts, funnels, derricks, winches, bollards, fairleads, stanchions, window frames, and the innumerable other fittings, were made in metal. There were 2,000 stanchions for the handrails. The method of making these was interesting and could be adopted by anyone with a lathe. The wire was fed through the hollow spindle of a lathe and allowed to protrude about 3 in. from the chuck. Very slightly below the centre were fixed two blades or formers shaped to suit the profile of the stanchion. The wire was fed out to a stop

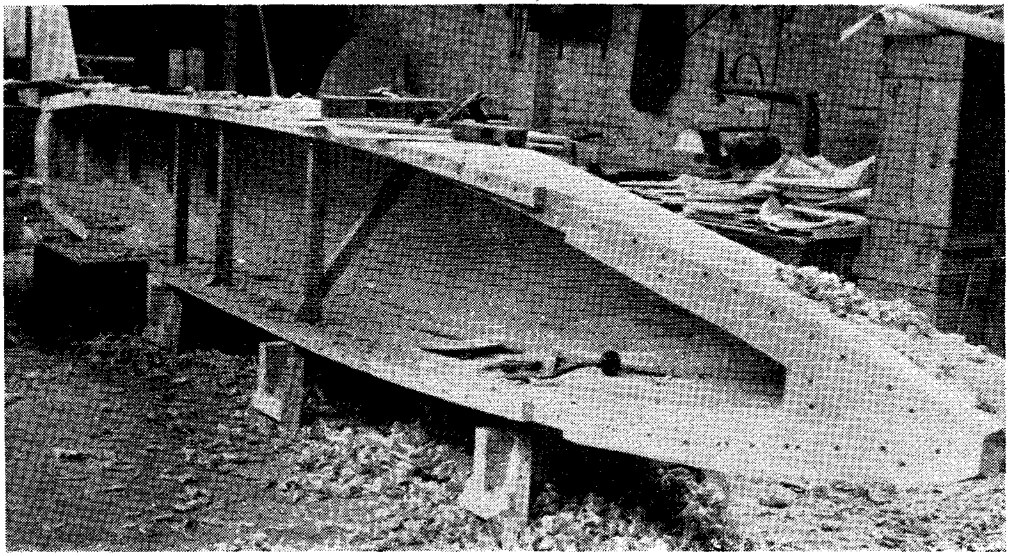


Photo No. 2. Shaping the sides. Note how much of the interior is removed for lightness

and then pressed down to pass between the formers. With a scraping action they turned out a perfect stanchion which was automatically parted off and dropped into a tray below. A small drilling jig was provided for drilling the holes for the handrails.

Many of the metal fittings, in particular the davits, were fabricated of metal. Each pair of davits was built up from 104 separate parts. These parts were hand-made in every case, as even for 26 pairs the cost of press tools would have been prohibitive. Similarly, with the masts; Photograph No. 5 shows one of these approaching completion. It will be noticed that the good old-fashioned soldering iron is being used for fixing a small fitting above the crow's-nest. The crow's-nest itself is a beautiful example of craftmanship in fabrication.

When we last saw the model, which was shortly before it was finished, the rigging was in progress. As will be realised, there is no quick way of doing this work, and here again the big commercial firm has no advantage over the amateur. Each item has to be treated individually. The length is cut from a coil of wire of the appropriate thickness and the ends turned in and spliced, and finally soldered with a small iron—sometimes an electric iron is impractical in view of the inaccessibility of the part. Our cover picture this week was taken at this stage

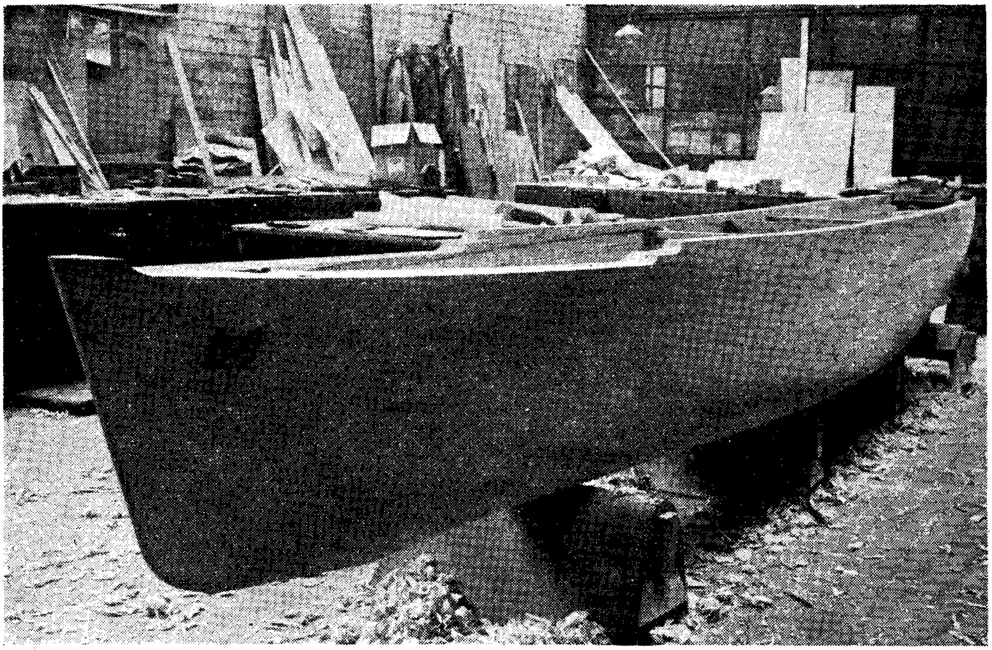


Photo No. 3. The hull ready for the superstructure. Note the delicate sheer line

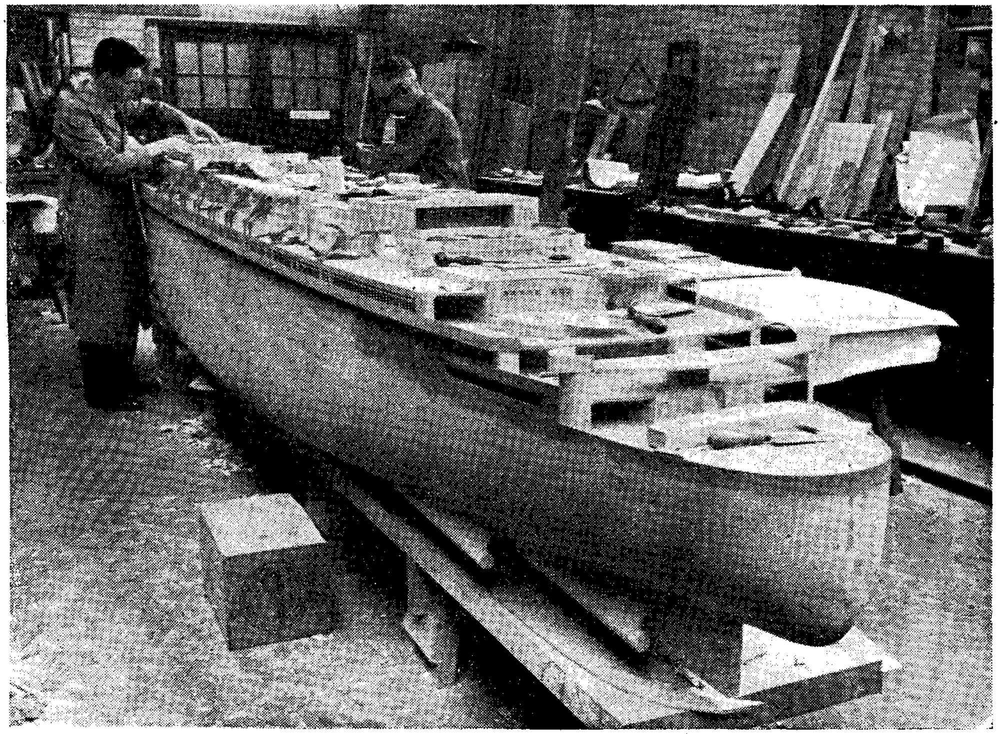


Photo No. 4. Erecting the superstructure

and shows one of the men actually at work on the rigging of the foremast. It will be seen that the stanchions were not fitted until a later stage as they are very liable to receive damage when the work is in progress.

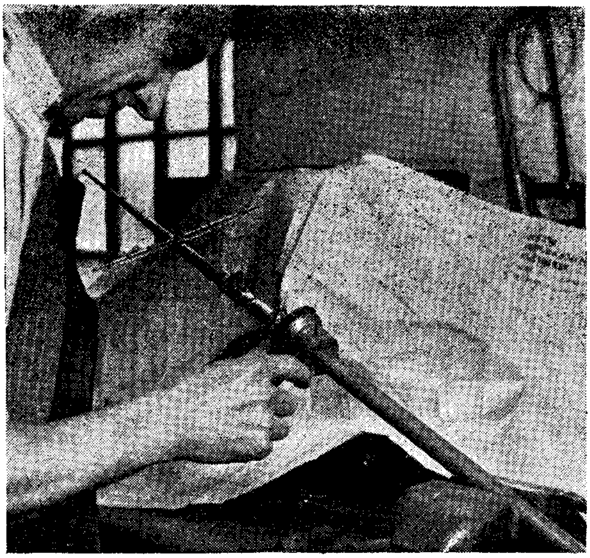


Photo No. 5. Fabricating the foremast

Basett-Lowke's models are noted for their wonderful finish. There is nothing magical about this. In every case it is the result of hard work and conscientious rubbing down of each coat. In the model we are considering, after the bare woodwork was carefully prepared it received 20 coats of paint, each of which was rubbed down to a smooth surface before the next was applied. The draft marks, the Plimsoll line and the famous white riband which is typical of all Cunarders were all hand-painted with the brush. The final coat of varnish was applied with the brush. Probably, in the case of the paintwork the amateur may not hope to possess the skill of the professional painter who has spent his life in acquiring it, but in the case of a super model it is surely justifiable to avail oneself of the services of an expert to obtain this finish. Our locomotive friends occasionally adopt this plan, especially when it comes to the lining of the model. The reflections on the side of the model as seen in the photograph on our cover give some indication of the finish obtained by Bassett-Lowke in their model of the *Queen Elizabeth*. Photograph No. 7 shows the finished model just before it left the workshop. An interesting point arose in this connection. The builders

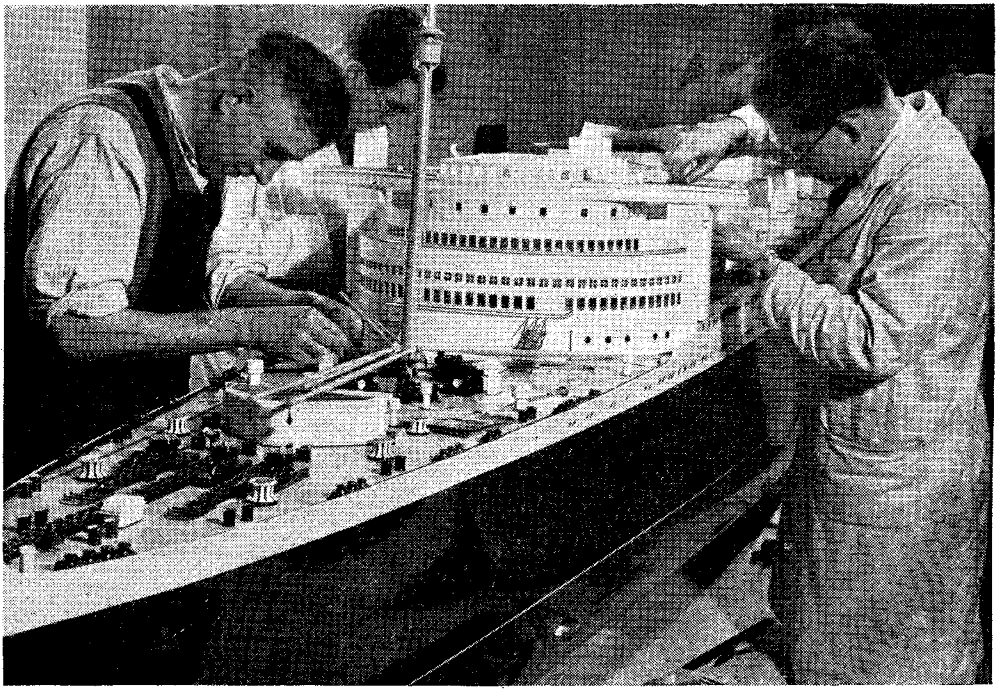


Photo No. 6. Building the bridge and erecting the fittings in the forecastle head

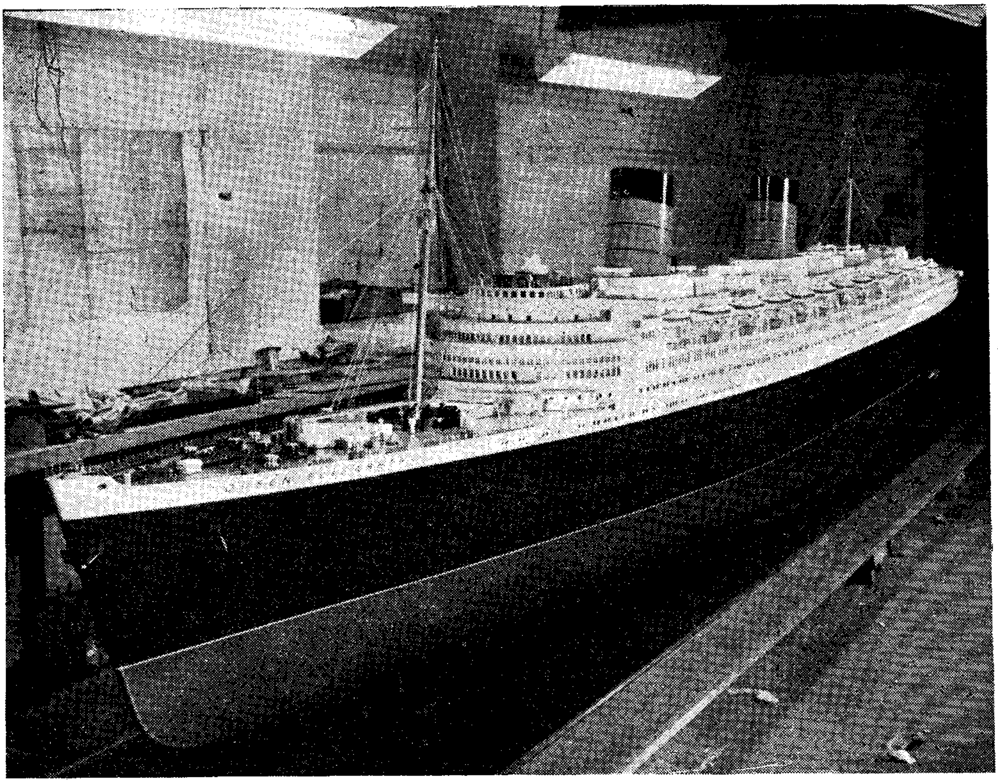


Photo No. 7. R.M.S. " Queen Elizabeth." The finished model

realised that, when finished, the model would be too big to be taken out of their works. They therefore hired a disused chapel and used it as a workshop in which to do the final assembly of the model.

In conclusion, we consider that as fellow craftsmen we should take off our hats to Messrs. Bassett-Lowke and their ship modellers in recognition of a fine piece of work, magnificently carried out, and one which will bring credit to British craftsmanship amongst our American cousins in New York, where it is to be exhibited.

For the Bookshelf

The Book of the Ship. By A. C. Hardy. (Sampson Low, Marston & Co. Ltd., London, W.1.) 30s. Large crown quarto. 322 pages.

All who are interested in the sea and ships will be familiar with the books of Mr. A. C. Hardy. They form a valuable series and are noteworthy for the original outlook and treatment of the subject. As stated in the introduction, he has written his latest book *The Book of the Ship* " to be the biggest, best informed and most thoroughly illustrated book on the ship in existence." As far as modern ships are concerned, he has certainly achieved his purpose ; nothing seems to have been overlooked. The building of the ship, its measurement, its machinery, its cargo, its purpose and its infinite variety are all dealt with in Mr. Hardy's capable style. The illustrations, both from photographs and drawings are quite a feature of the book, and include a series of elevations showing practically every type of ship, another series of sections showing arrangements of hold and machinery in all types of cargo ships, and a third series giving plans and elevations of a passenger liner, a cargo and passenger liner, a motor tramp, a tanker, a coaster, a pilot cutter, a fruit carrier, and a trawler. These are of the greatest value to the modelmaker, and the whole book will prove a fascinating mine of information, the study of which will increase his interest and enthusiasm for his hobby.

Model Power Boat Regattas

Some Suggestions for their Organisation

by J. H. Benson

THE organisation of a successful regatta for model power boats is sometimes a bit of a headache to those club officials to whose lot it may fall, especially if the club concerned is not primarily a power boat club and without previous experience of running an event of this nature. I hope that these notes will prove of assistance to both intending competitors and club officials alike.

If the regatta is to be run under M.P.B.A. rules, the competition rules of the association should be studied, especially the rules which specify the tethering-line and fittings in the case of speed events, and the rules relating to boats running in straight-course events and steering competitions.

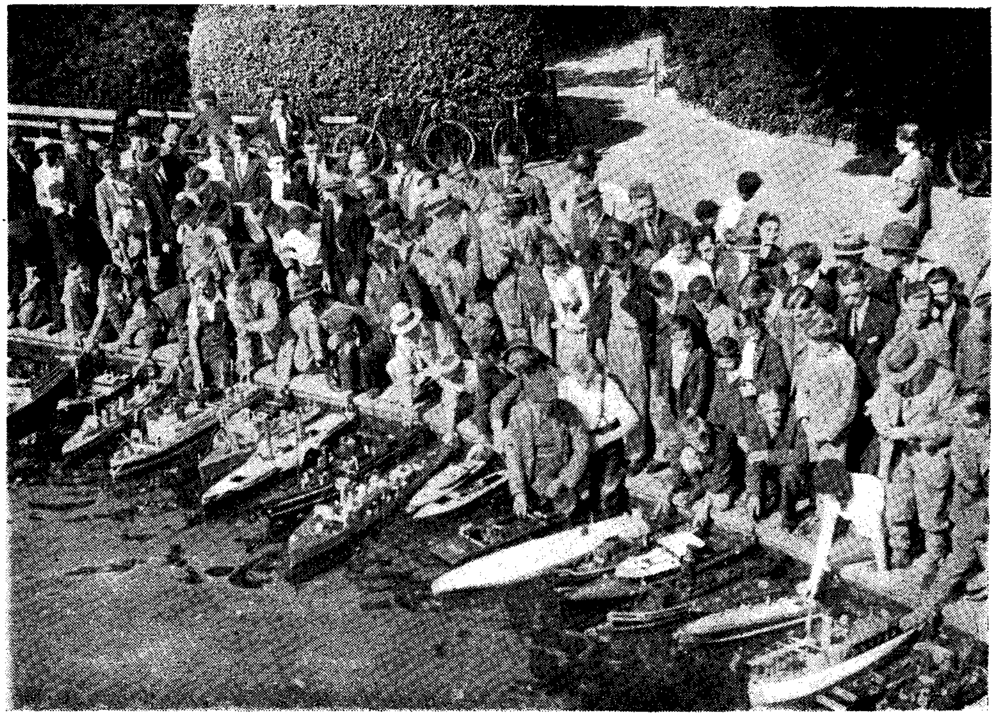
A full regatta programme consists of events for all classes of boats as recognised by the M.P.B.A., but should a club either not have the facilities for running an event, or consider that not enough boats are likely to be entered, they are at liberty to delete the event from the programme. In fact, it is entirely up to the home club what events they hold, but it is as well to make quite clear in any club notices announcing the regatta, what events *are* being held.

A typical "full" programme would read as follows:

Event 1 500 yd. race for Class C boats.
" 2 500 yd. race for Class C (restricted) boats.
" 3 Nomination race for straight-running craft.
" 4 500 yd. race for Class B boats.
" 5 Steering Competition.
" 6 500 yd. race for Class A boats.

Time permitting, a lunch interval could be fitted in between events 3 and 4. If a good attendance of boats in all classes was obtained, the above programme would take about 6½ hours to run, this means a prompt 11 a.m. start in order to finish by 5.30 p.m.

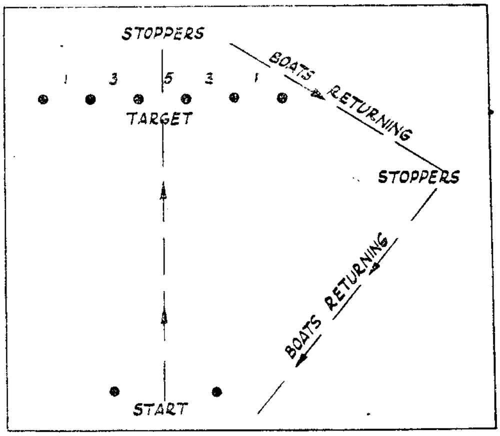
It will be noticed that in the above programme the straight-running events are spaced between speed events, this is not essential but is better from the spectators' point of view, and also for the



A typical scene at the pondside during the regatta season

owners of steering craft who do not have to feverishly refuel their boats, as is the case where the steering event immediately follows the nomination race.

I will now give a fuller description of the events, officials and equipment required to run them, commencing with events for straight-running craft.



Nomination Race

The owners of the various boats each give in an estimated time for their boat to complete a given course, and the boat completing the course nearest to its nominated time is the winner. This event is quite a test, both of steadiness of running, and also of steering, since should the boat run off course it will put many seconds on to the time taken for completion. The distance should not be less than 45 yd. and not more than 100 yd., but the course should be a measured one in order to give everyone the same chance; unspecified courses sometimes favour the home members. If a boat runs off course it may be deflected by stoppers placed along the sides of the pond or lake. (This may not be possible on some waters.)

The officials for this event are: (1 and 2) starter and timekeeper. These officials control the event from the *starting end*, as each competitor comes up to the start he can identify himself to the starter, and upon the O.K. to start being given, the timekeeper starts his watch as the nose of the boat crosses the line. At a pinch, one person could combine these jobs. (3) A flagger to indicate when nose of boat crosses the finishing line—stoppers will also be required.

The equipment required: 4-6 buoys for marking the course. An easily seen flag for the flagger at finishing end; stop-watch; a whistle is also useful to attract the flagger's attention when a boat is coming up the course.

Steering Competition

This event is a test of the boats' straight running abilities; each boat is allowed three runs at the target and scoring is usually taken as 5 points for a bull, 3 for an inner and 1 for an outer (see diagram). The distances between markers should be governed by the length of course, e.g., for a 40 yd. course, markers could be 3 ft. apart, for a 75 yd. course, say 5 ft. Greater distances than 75 yd. are likely to result in many boats failing to score, thus reducing interest in the event.

Two officials are required for this event—a scorer and a course steward, the latter should have waders on and control the competitors at the starting point. After each tilt at the target, boats should be returned to their owners as quickly as possible. The system of returning boats must, of course, vary with the type of lake and its depth, shape, etc.; but a good way is to station some stoppers to the side of the course, and returning boats are sent to them first and then back to owners.

Equipment: Six markers or buoys for the targets, two buoys for the starting point. It is suggested that if the markers take the form of metal stakes with discs attached, the shaft should be covered by rubber tubing in order to protect boats from damage. In the event of a tie between boats, each boat is allowed one further run at the targets, the boat making the higher score naturally being placed higher. (This only applies to ties for places in the first three.)

Speed Events

There are now four recognised classes of racing hydroplanes. Classes A, B, C, and C (restricted), but all are run off in the same manner, the only change is in the strength of the line for the different Classes. At the moment, these are Class A, 120 lb., Class B, 80 lb., Class C, 50 lb., but there is some likelihood of these strengths being upgraded in the near future due to the high speeds now being obtained.

It is usual to allow each boat two runs and two starts per run. A "start" is counted as when the boat is released by the competitor, but before the timing commences at the half lap. Should the boat stop after the timekeepers start their watches, it is counted as a "run."

The order of running can be decided by draw if desired, and each competitor should get in his first run before any of the others make their second attempts; thus the event divides into two "rounds," which allows a little time for adjustments, etc., before a boat is due on again.

It is sometimes desirable to fix a time limit on the line, for if a boat proves a bit stubborn in starting, it is liable to get rather boring from a spectator's point of view, more especially if several "non-starters" follow one another!

There will be three officials required, or four if the line is taken care of by a "line-steward." The main officials are, however, two timekeepers and a course steward.

The minimum equipment required will be: Tripod or other fixture, lines, two stop-watches, a buoy for marking the half lap position (placed just outside the sweep of the circular-course).

If some kind of electrical timing equipment is available, it can be used and will eliminate one of the stop-watches.

The type of tripod used will depend on the pond or lake used, but if the tripod is not anchored by some means, ample weights should be used to

(*Continued on page* 477)

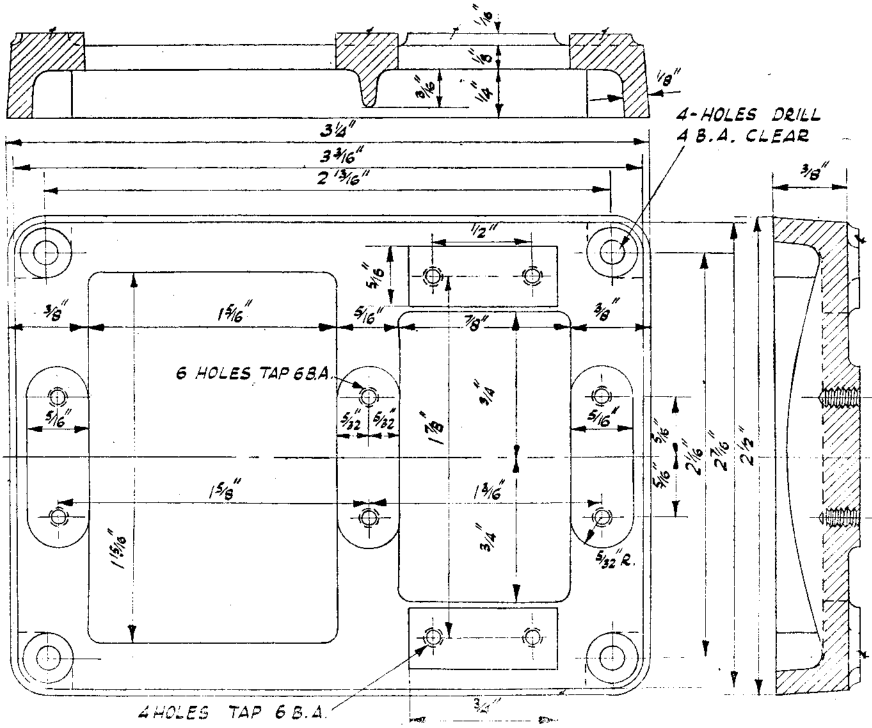
*UTILITY STEAM ENGINES

by Edgar T. Westbury

MANY of the machining operations on the components for the "Spartan" engine are similar to those on corresponding parts of the "Warrior" engine, which have already been described in detail, and, therefore, do not call for more than a brief comment in the present case. Where there are divergencies in design and method of procedure, the single-acting engine is generally simpler in machining and fitting than the double-acting type, as the necessity for exact alignment in such parts as glands and cross-heads is eliminated. Nevertheless, there is just as much scope for care and skill in the construction of this or any other comparable type of engine, and particularly in cases where a high speed and maximum power output are required, the soundness and accuracy of workmanship may be a deciding factor in the engine's success.

Bedplate

In order to reduce weight, the bedplate and trunk column of this engine are cast in light alloy, but this feature is optional, and gunmetal castings may be used if preferred. It resembles that of the "Warrior" engine in general character, though not in detail, and similarly calls only for machining the facings on the top surface, after a check-up on the essential flatness of the casting, and possibly filing or skimming the underside rim. To ensure the highest degree of accuracy, the truth of the machined surface should afterwards be tested on the surface plate, and any minor irregularities corrected by scraping or lapping. The drilling and tapping operations may be deferred till a later stage in the construction.



Bedplate for the "Spartan" engine

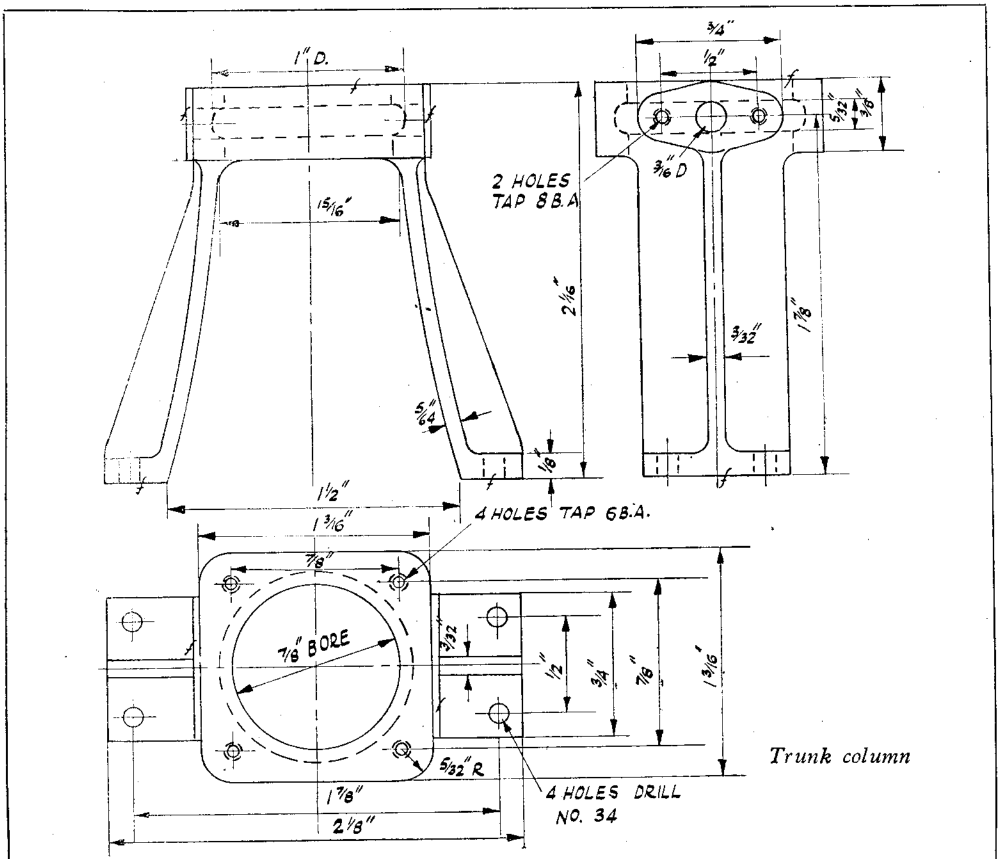
Trunk Column

The procedure in machining this part also follows methods which have already been described, but as it is shorter than that of the "Warrior" engine, it may be dealt with in a somewhat simpler manner, avoiding the need for using a mandrel to mount the casting for machining the feet. In this case, it is held by the top end in the four-jaw chuck, setting this end to run as truly as possible, with regard to both radial and

*Continued from page 424, "M.E." April 7, 1949.

axial truth at the tips of the feet ; any error in this respect should be corrected by tapping with a mallet before the chuck jaws are tightened. As there is a good deal of spring in the legs of the casting, it may not be found easy to get a good finish when facing the feet. A sharp and narrow-edged tool—practically a point tool—should be used, and in the event of chatter-marks or ridges being left, in spite of the utmost care, the surfaces may be afterwards scraped or lapped.

While held in the chuck, the bore of the casting may also be machined at the same setting, including the groove or chambering to form the exhaust collector-ring. The depth of this groove is not highly important, but it should not be less than the drawings indicate. After removing the casting from the chuck, it is clamped by the feet to the faceplate for facing the top surface ; exact concentric truth is not essential if the boring has been carried out at the first setting.



Trunk column

Cylinder

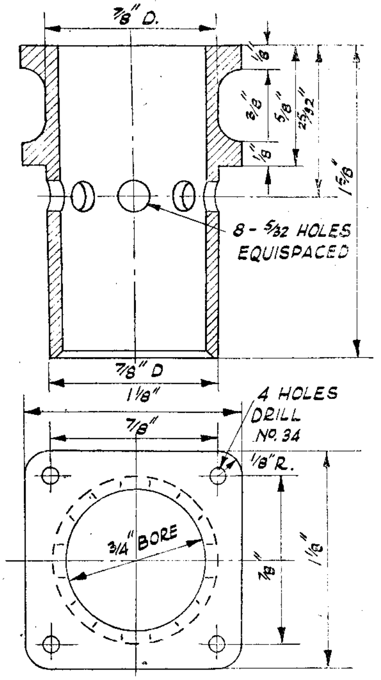
Cast-iron is the best material for this component, and it may be machined all over at one setting if provided with sufficient extra length to form a chucking-piece. The skirt of the cylinder should be a fairly tight push fit in the bore of the trunk column, and some care in fitting this is worth while to prevent leakage of steam or condensate, especially if there is any likelihood of experimenting with an exhaust condenser, which is certainly well worth while in connection with this type of engine. In boring and finishing the inside of the cylinder, the constructor will do well to follow the methods which have so often been described in THE MODEL ENGINEER for similar operations in i.c. engines. While the engine will run after a fashion with an imperfectly fitted cylinder and piston, both efficiency and economy are bound to be adversely affected, and one cannot over-emphasise the importance of this detail in cases where high performance is required.

The drilling of the exhaust ports should be carried out after rough lapping, but before final finishing, of the cylinder bore. If it is desired to experiment with compression ratios, the length of the top end of the cylinder, above the lower flange, may be left greater than that specified.

Cylinder-Head

This should be made either in cast-iron or hard bronze ; if a softer material is used, it will call for an inserted valve seating, but in any case, it may be observed that neither aluminium

alloy nor soft brass are suitable metals to withstand the high temperature or scoring effects of superheated steam. Phosphor bronze—that much overrated metal !—is not the best material, either, for high temperature, manganese bronze being preferable if obtainable, though the former metal is certainly more reliable than the dubious mixtures often vaguely termed "gunmetal." However, one generally has to be



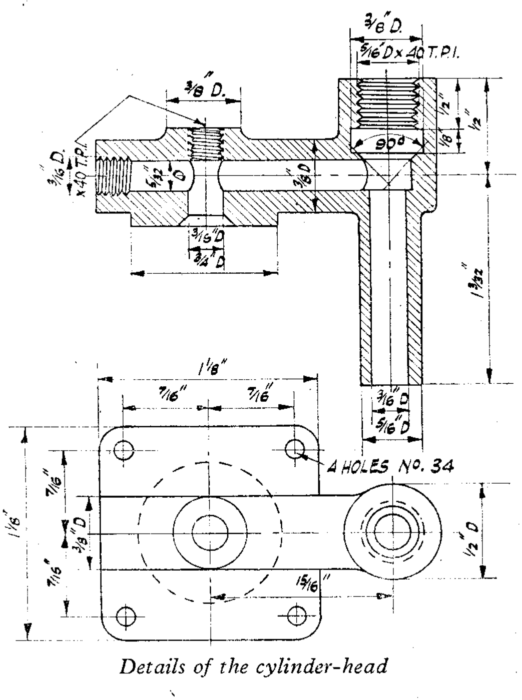
Section and plan of the cylinder

grateful for small mercies where castings are concerned, and it is sometimes indiscreet to enquire too closely into the origin of the brew concocted by the High Priest of the Melting Pot !

The casting may be held by the corners of the flange for facing the underside joint surface and machining the register spigot. Care should be taken to set the casting so that the outside of the valve guide is parallel to the lathe axis, which may be checked by holding a square on the face of the chuck and presenting it to three sides of the valve chamber. A special narrow facing tool, presented axially, and projecting far enough from the toolpost to clear the valve guide, will be necessary to enable the flange to be faced right out to its corners. The spigot should be a neat push fit in the cylinder bore, and its projecting length will obviously influence the compression ratio, and may be subject to modification for adjustment in that respect.

A hole may be drilled through the centre of the spigot at this setting, to be tapped and spot-faced at the top end to take the cylinder drain tap. It will be observed that there are two alternative positions for the latter—at the top or side of the head—and if the latter position is preferred, it is not necessary to drill the vertical hole right through, in which case the top boss may be removed, and the top of the casting filed to shape, as shown in the end section of the general arrangement drawing.

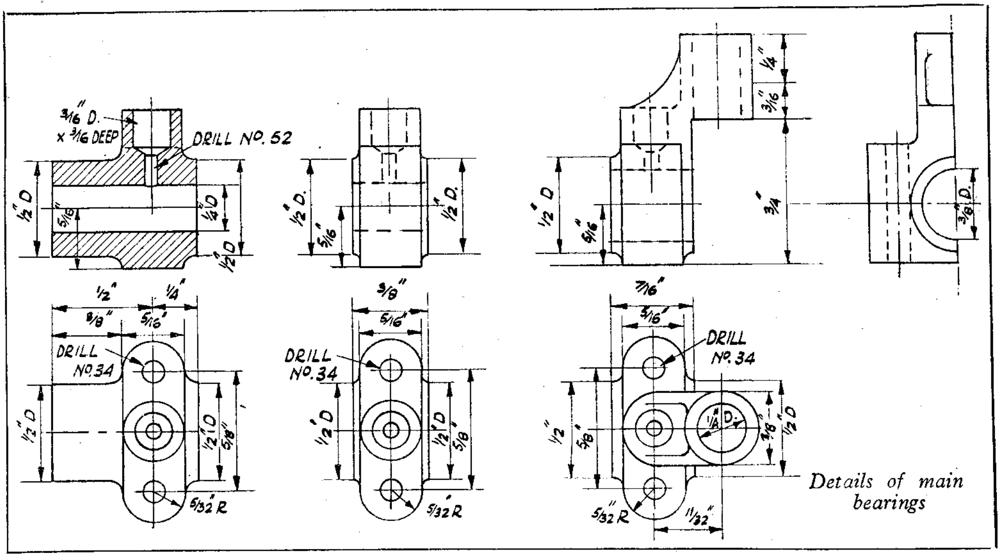
As the exact location and alignment of the poppet valve do not vitally affect the operation of the engine, it will be sufficiently accurate to hold the valve guide in the three-jaw chuck and drill and counterbore it from the top end at one setting. Care should be taken to ensure concentric drilling, and the guide bore should be finished with a reamer or D-bit, taking out the minimum amount of material at the final cut. Open out the top end of the hole to 19/32 in. for tapping, and face the top surface ; then chamber out the space above the valve seating to ⅜ in. diameter. The seating may, if desired, be bevelled to an included angle of 90 degrees at this setting, but as it is very difficult to see what one is doing, I prefer generally to cut this seating afterwards by means of a piloted cutter, operated by hand, and this tool will be found useful, if not essential, in subsequent servicing of the engine. Finally, the horizontal steam passage in the head is drilled, and the outer end tapped and spot-faced.



Details of the cylinder-head

Main Bearings

Leaving the "top end" of the engine for the moment, the bearings may now be tackled ; there are three of them, all different, made from bronze castings, which need not be split, though there are some advantages in doing so, at least in the case of the two bearings which support the main crankshaft. For the extra amount of



Details of main bearings

trouble in machining split bearings, however, most constructors will consider them hardly worth while, and the solid bearings are quite satisfactory for practical purposes.

The castings may be chucked for boring and facing, and it will be seen that two of them are $\frac{1}{4}$ in. in the bore, the third being $\frac{3}{8}$ in.; the latter also has a vertical extension which is drilled and reamed $\frac{1}{4}$ in. diameter to form a tappet guide. To ensure that the centre-lines of the bearings are all at the same height from the base surface, they should be mounted all together on a mandrel for facing the underside. It will be necessary to make a stepped mandrel having a seating in the centre for the $\frac{3}{8}$ in. bore and $\frac{1}{4}$-in. seatings either side, made to take the bearings a light press fit in each case. The length of the mandrel should be sufficient to allow of it being used afterwards for lining up the bearings *in situ* on the bedplate. When mounted on the mandrel, the bases of the bearings should be lined up and filed or machined so that the undersides are dead flat and exactly parallel to the mandrel axis. The holes for the holding-down studs are then marked out, squarely and symmetrically to the shaft axis, drilled, and spot-faced on the top surface; the oil holes may also be drilled and counterbored. If it is intended to fit the engine with forced lubrication, the mouth of the oil well may be tapped $\frac{3}{16}$ in. $\times$ 40 for fitting a pipe union.

(*To be continued*)

Model Power Boat Regattas

(*Continued from page* 473)

prevent it being pulled over. One club uses quite successfully a long steel stake driven into the bottom with the aid of a sledge-hammer. Ball-races should be used for the tripod swivel in all cases.

Financial Cost of Regatta

Many of the smaller clubs may be deterred from holding a regatta for financial reasons, but the cost of prizes need not be great. Model power boat fans are not "pot-hunters," and in most cases quite inexpensive prizes are sufficient. If desired, only first and second prizes need be awarded in each event, especially if the number of entries is fairly small.

I should advise clubs to plan their regattas something after this manner.

(a) Discuss and decide what events can be held.
(b) Estimate cost of prizes, etc. (Local Model Engineering Trade firms may help here.)
(c) See that appropriate equipment is available for all events to be run.
(d) Arrange for transport of equipment to pondside.
(e) Appoint reliable officials for the various events. (Confirm these officials as close to the chosen date as possible.)
(f) Arrange for due publicity of the regatta.

Now just a word to intending competitors. If you are a newcomer to competition work, don't be scared to take part, power-boat men are a friendly lot, and they certainly won't criticise your boat however humble it may be.

To speedboat men I would ask: give a hand as stoppers in the straight-running events, especially if the home club is short-handed; and to prototype and steering competitors, I also have a plea: Don't move around in the water or run craft while the speed events are in progress, as it may cause disaster for some unfortunate.

In conclusion, attend all the regattas that you are able, and so assist in their success, and get the fullest enjoyment out of our grand hobby.

IN THE WORKSHOP

by "Duplex"

*35—Additions to Machine Tools

(3) Attachments for increasing the speed range of the drilling machine

IN some small workshops, where for the most part light work is undertaken, the single drilling machine installed may be one having a chucking capacity of $\frac{1}{4}$ in. or, perhaps, $\frac{3}{8}$ in., and, on the ground of expense, carbon-steel drills are generally used.

When employing a $\frac{1}{16}$-in. diameter carbon-steel drill for machining mild-steel, an appropriate speed for accurate working would be 3,000 to 6,000 r.p.m.; but where a $\frac{1}{4}$-in. diameter hole is drilled in hard cast-iron, the drill will tend to become quickly blunted and its point worn if a speed of some 400 r.p.m. is exceeded, or 250 r.p.m. in the case of a $\frac{3}{8}$-in. diameter drill.

Those who have had much experience of drilling cast-iron will have discovered that if the speed is too high, or if the drill is allowed to rub in the work without taking a proper cut, then both the point and the sides of the drill are worn away so that it ceases to cut effectively and tends to jam in the work.

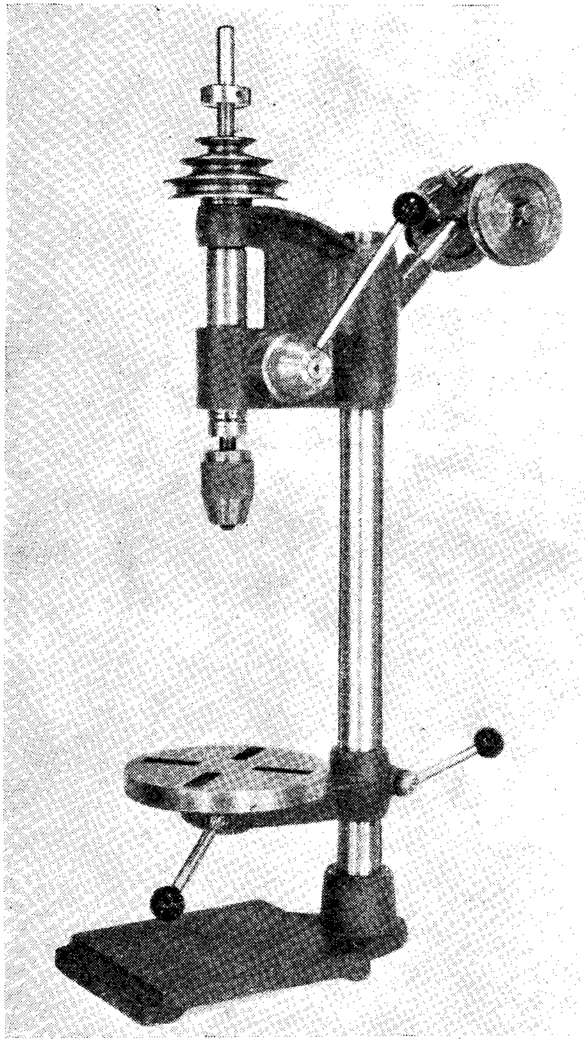


Fig. 1. The Cowell drilling machine in its standard form

The remedy for these troubles is, clearly, to run the drill at a slower speed and at the same time to increase the rate of feed.

In industry, the problem of drilling at the correct speed in order to maintain output is solved by allotting the work to the appropriate machines, but the single drilling machine found in the small workshop commonly has a speed range that provides a slow speed of only about one-quarter of the highest speed.

In these circumstances, it will be apparent that if the $\frac{1}{16}$-in. drill is run at the correct speed, then the $\frac{1}{4}$-in. drill will be driven much too fast. Moreover, if an attempt is made to drive the 3-in. diameter large pulley on a small drilling machine from an electric motor rated at 1,450 r.p.m., then to obtain a spindle speed of 400 r.p.m. the motor pulley would need to have a diameter of rather less than 1 in.; which is, of course, impracticable with the ordinary form of drive by means of a single round belt.

Apart from the low speeds required for the drilling operations cited, even slower speeds are at times an advantage when countersinking or

*Continued from page 414, "M.E.," April 7, 1949.

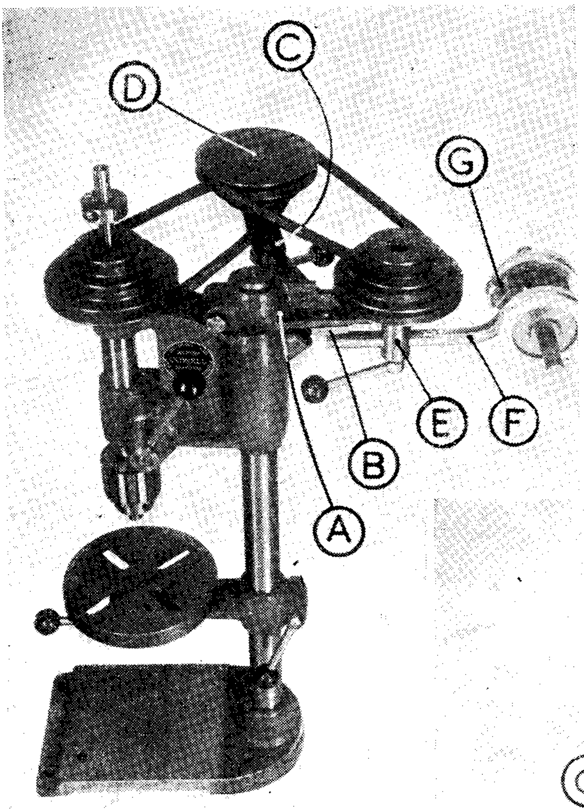


Fig. 2

counterboring holes, particularly in the case of cast-iron to avoid blunting the tool, or to prevent chatter when machining brass.

As a result of being approached by owners of small workshops who had encountered the difficulties described, it was decided to try to equip two drilling machines with attachments that would provide a range of speeds adequate for all ordinary purposes.

The machines thus dealt with were the ¼-in. capacity Champion drilling machine, which has been widely used for many years past, and the ⅜-in. capacity Cowell machine of somewhat similar design but of more recent development.

With regard to the general features of the drive, the ordinary round leather belt is quite satisfactory when working at high speeds, and where jockey pulleys are used both to change the direction of the drive from the vertical to the horizontal plane, and to provide a simple means of adjusting the belt tension.

However, for the final low-speed drive to the drill spindle a round belt is hardly suitable, as it does not have sufficient grip, particularly where the drive centres are close together.

On the other hand, where the drive is correctly designed, the V-belt grips well even at low speed, for the latest patterns of this type of belt are extremely flexible and well adapted for running on small pulleys even at short driving centres.

Before going further, to get a general idea of the construction of the attachment, reference should be made to the photographs in Figs. 1, 2 and 3 which show the appearance of the Cowell machine, both in its standard form and with the supplementary driving gear fitted.

It will be seen that the usual belt drive from the motor is taken over the adjustable jockey pulleys to the first driven pulley, thence the power is transmitted to the machine spindle by means of a two-stage V-belt drive, using 3-step pulleys to increase the speed range.

The speed range obtained, when using a 1⅞-in. diameter pulley attached to the shaft of

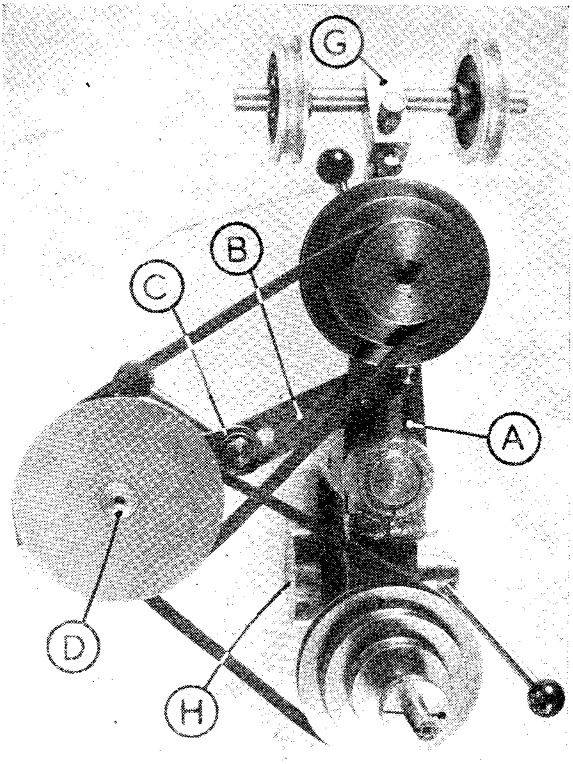


Fig. 3

a motor running at 1,450 r.p.m., is approximately from 150 to 4,400 r.p.m.

Changing the V-belts on the pulleys to alter the drive ratio is rendered extremely easy by fitting a slotted and pivoted arm to carry the intermediate driving pulley, so that when the ball-ended clamping lever is loosened the two belts concerned become quite slack. This method of mounting the pulley also allows the two V-belts to be automatically re-set in equal tension.

clamped in place by means of its $\frac{5}{16}$-in. diameter pinch-bolt. At its outer end the bracket carries the pivot (*E*) on which the first driven pulley rotates; this pivot is fitted in place of the drilling table and is secured in the bracket by tightening the $\frac{5}{16}$-in. diameter clamp-bolt.

To carry the second cone pulley fitted to the pivot (*D*), an arm (*B*) is attached to the casting (*A*) by means of two $\frac{3}{16}$-in. or $\frac{1}{4}$-in. diameter bolts. It will be noted that the arm (*B*) fits against the flat under surface of (*A*), and for this purpose the bracket is drilled and then spot-faced on its upper surface to provide a flat seating for the heads of the securing bolts.

Reference to the working drawing in Fig. 4 will show that the vertical web and the smaller boss on the casting (*A*) have been filed or machined away to reduce the thickness to 27/32 in.; this serves the double purpose of maintaining the correct alignment of the belt and also providing a working clearance for the belt when running in the lowest groove of the pulley.

This drawing shows, too, that the underside of clamping lug of the large boss must be filed with a flat to allow the bracket to fit against the headstock casting.

The arm (*B*), which should be made from mild-steel bar, has its outer end slotted, as shown in the working drawing in Fig. 4, to allow for slackening and tightening the belts. After it has been bolted in place, the arm is marked-out to enable the end to be finished obliquely to match the bracket casting.

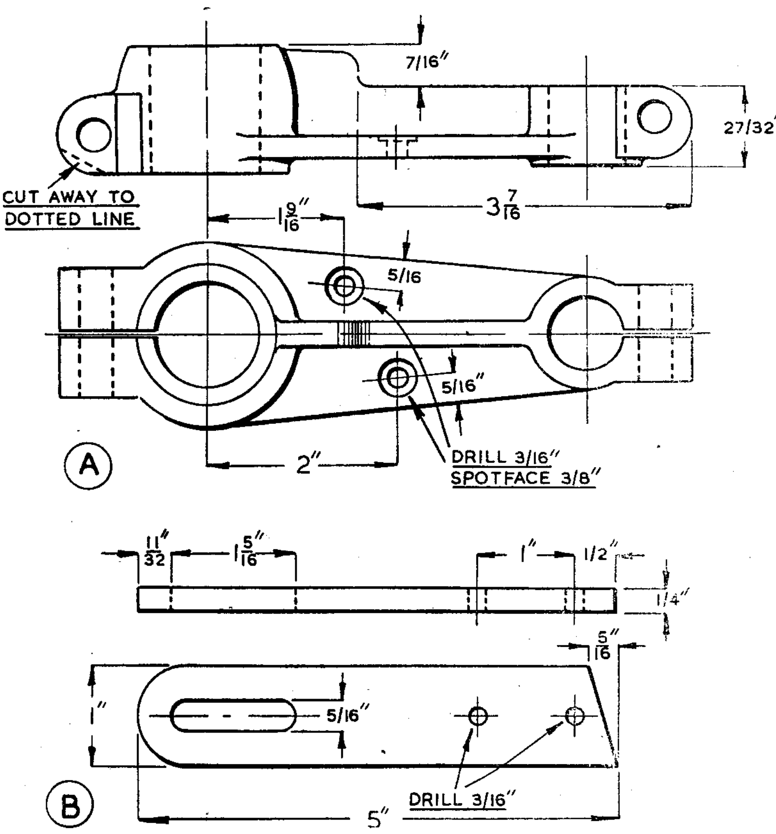


Fig. 4

Adapting the Cowell Machine

It should be noted that the letters assigned to the various parts in Fig. 2 are also similarly used in the working drawings given in Figs. 4, 5 and 6.

The conversion has been simplified by making use of standard parts wherever possible, and by constructing the subsidiary fittings from material commonly to be found in the workshop; moreover, the machining and fitting operations required are quite straightforward and need no special skill or equipment.

The Pulley Bracket (A)

This is the standard table bracket as shown attached to the lower part of the column in Fig. 1.

The bracket is fitted in the inverted position to the upper end of the drill column, where it is

The Swing Arm (C), Fig. 5

This part, also made of flat mild-steel, is clamped to the upper surface of the arm (*B*), and at its outer end it carries the pivot (*D*) on which the second or intermediate cone pulley runs. The small swing arm has pressed into it a $\frac{5}{16}$-in. diameter B.S.F. bolt, so that when the standard pattern ball-ended handle shown in the drawing is tightened, the arm (*C*) is secured to the arm (*B*).

It is essential that the clamping-bolt should fit tightly in the swing arm so that it does not turn

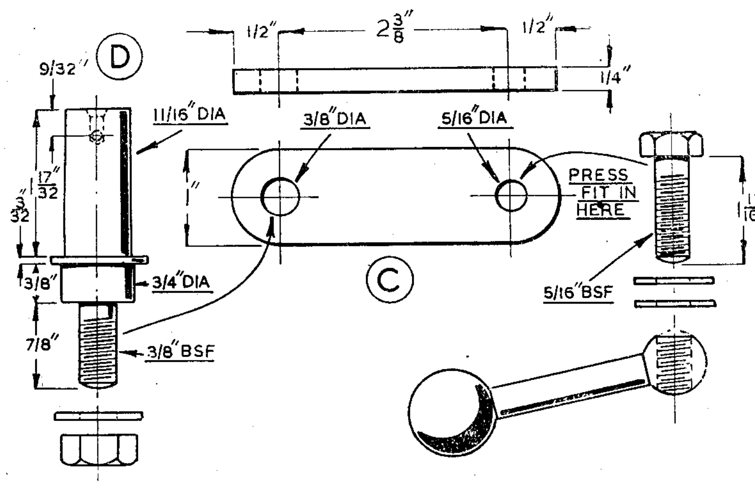


Fig. 5

when the belts are being adjusted ; if preferred, a snug or register-pin can be fitted under the bolt-head to serve this purpose.

Machining the Bore of the Intermediate Pulley

The standard pattern spindle cone pulley, which is fitted in the inverted position to run on the spindle (*D*), is made with an internal driving collar that must be machined away before the pulley can be mounted in place. To do this, a piece of round bar is gripped in the self-centring chuck and its end is turned down to a firm push fit in the larger diameter of the pulley bore ; with the pulley mounted on this arbor, the internal collar is bored out and the pulley bore thus made parallel.

If desired, the bore can be finished with a reamer, but a final lapping operation will produce the best form of bearing surface.

The Pulley Pivot (D), Fig. 5

This short spindle is bolted, as represented in the drawing, to the outer end of the swing arm (*C*) ; and in order to maintain the correct belt alignment it is essential to machine the part to the dimensions given.

It will be seen that the upper end of the pivot is drilled to provide a small reservoir and an oil-way for the lubrication of the bearing. The bearing surface is made an accurate working fit in the pulley, and the life of the component will be prolonged if it is case-hardened and finally lapped to size.

The Pulley Spindle (E), Fig. 6

As previously mentioned, this spindle is gripped in the small end of the main bracket casting and secured in place by means of the clamping-bolt fitted.

In this case, the internal collar in the bore of the standard pulley here used rides on the upper end of the pivot, and thus locates the cone pulley

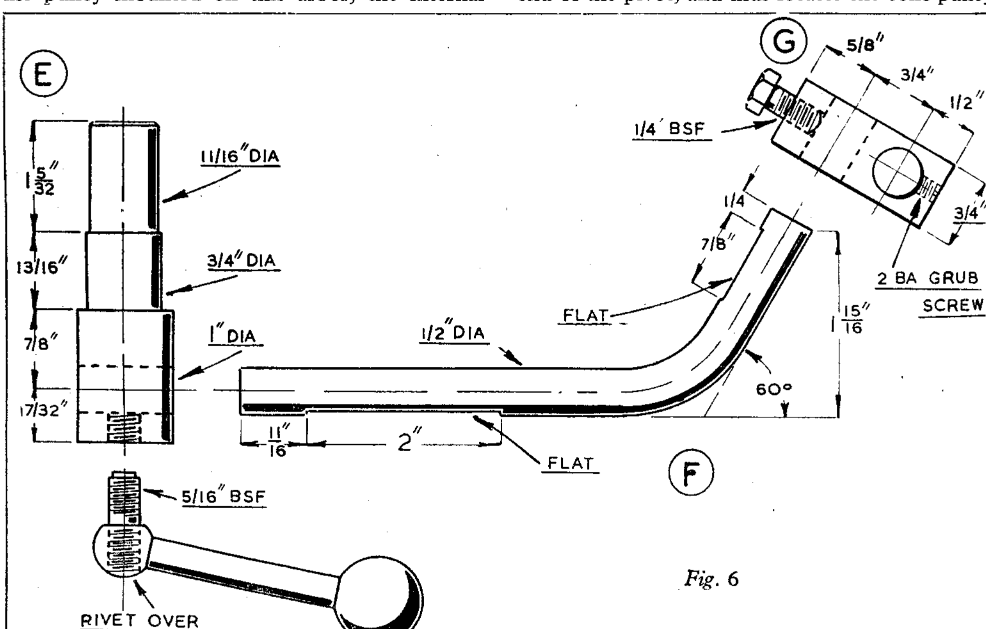


Fig. 6

and keeps it just clear of the web on the upper surface of the bracket casting.

The lower end of the 1-in. diameter round mild-steel bar, from which the part is made, is cross-drilled ½ in. in diameter to receive the shaft of the jockey pulley assembly.

Finally, a short $\frac{5}{16}$-in. diameter B.S.F. stud is set in a standard pattern ball-ended handle, and this handle is fitted to the pivot member for the purpose of securing the jockey pulley shaft after adjustment of the driving belt tension.

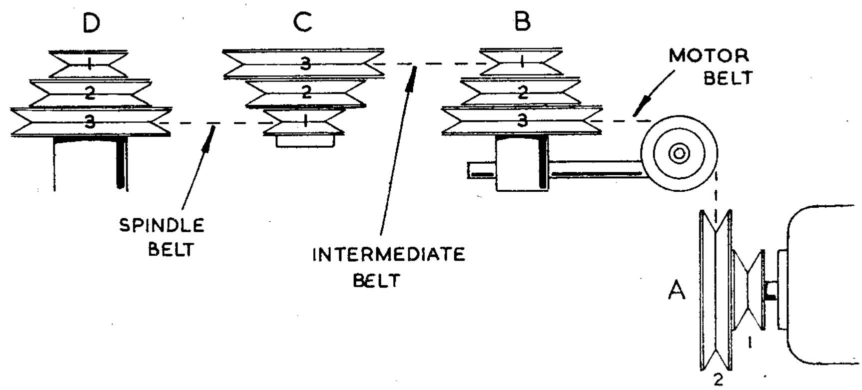
The Jockey Pulley Mounting, Fig. 6

The shaft (*F*) carrying the jockey pulley assembly (*G*) is made from a length of ½-in. diameter round mild-steel. As shown in the drawing, a flat is formed on its lower surface to maintain the pulleys upright at any setting of the belt tension ; likewise, a flat is also filed on the upper surface of the shaft to locate the jockey pulley bracket correctly. The shaft should be heated and then bent to an angle of approximately 60 deg. in order to provide for the proper alignment of the driving belt.

The standard form of fitting for carrying the spindle on which the jockey pulleys run can be utilised or, if preferred, a shorter form of bracket, as illustrated in Fig. 6 (*G*), can be machined from a length of ¾-in. square mild-steel.

This completes the machining of the attachment, and at the final assembly, care should be taken to make sure that all the pulleys run freely on their shafts and, at the same time, maintain the correct belt line.

If the work has been well carried out, all the adjustments should work freely, but the ball handles may need to have washers of the correct thickness fitted in order to bring them into a convenient operating position.



BELT POSITIONS			SPINDLE SPEED R.P.M	BELT POSITIONS			SPINDLE SPEED R.P.M
MOTOR BELT	INTER BELT	SPINDLE BELT		MOTOR BELT	INTER BELT	SPINDLE BELT	
A1–B3	B1–C3	C1–D3	145	A2–B3	B1–C3	C2–D2	900
A1–B2	B1–C3	C1–D3	225	A1–B3	B2–C2	C3–D1	1450
A1–B3	B1–C3	C2–D2	320	A1–B2	B3–C1	C2–D2	2000
A1–B2	B1–C3	C2–D2	450	A1–B2	B3–C1	C3–D1	4300
A2–B3	B1–C3	C2–D2	640				

Speed range table

The Belts

The two V-belts fitted are of the " M " Type No. 2220, manufactured by Messrs. J. H. Fenner & Co., having a width of ⅜ in., a thickness of 7/32 in. and an inside length of 20.4 in.

These belts were chosen for their extreme flexibility, which results from forming the core of five strands of round nylon thread, placed in a line across the width of the belt ; moreover, the belts are jointless, as they are formed in a special mould for each length of belt.

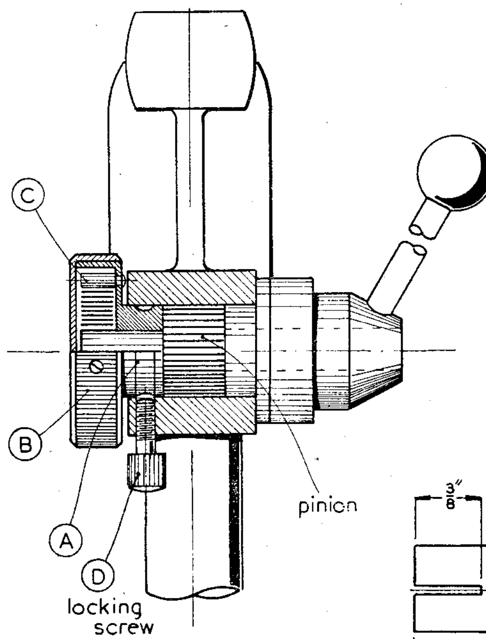
As previously mentioned, V-belts grip well even at low speeds, provided that the pulley grooves are correctly machined in accordance with the makers' instructions relative to each type of belt ; in addition, the tension must be adjusted to prevent slip, as this greatly shortens the working life of the belt.

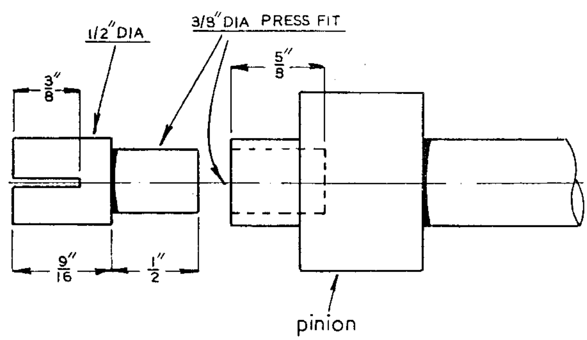
The tension of the V-belts is adjusted by pulling on the lower projecting end of the spindle (*D*) with the crook of the left index finger, and then tightening the ball-ended lever to secure the swing arm to the arm attached to the main bracket.

This procedure causes both belts automatically to take up the same tension.

The tension of the round driving belt is, of course, set by adjusting the position of the shaft carrying the bracket on which the jockey pulleys are mounted.

A two-step V-pulley is used on the motor driving shaft, as this gives a more even increase of spindle speeds towards the middle of the speed range. Where a pulley of this form is employed, it should be fitted with the larger step towards the drilling machine so that the belt, when running on the smaller step, will not foul the sides of the larger pulley as the belt line alters with the adjustment of the belt tension.





Above—Fig. 7

Right—Fig. 8

The range of speeds obtainable when using this attachment are given in the reproduced table.

Adjusting the Return Spring Tension

In order to obtain sensitive operation of the drill feed, particularly when using small drills, it is essential that the return spring fitted to the drill spindle should have an action that will enable the drill to be brought into contact with the work by the application of only light finger pressure.

In fact, it is an advantage if the spring tension is only just sufficient to raise the spindle to its full height, and the hand pressure applied is then expended almost entirely in feeding the drill.

Owing to the difficulty at the present time in obtaining springs suitable for this work, it was found that the spring pressure controlling the feed in the Cowell machine was somewhat excessive. It was decided, therefore, to equip the machine with a device to make the tension of the return spring adjustable. For this purpose, the spring is housed in a cylindrical box which is turned to wind up the spring and so increase its operating tension. In this connection, it is essential to fit a spring of ample length, otherwise its tension will vary appreciably with the movement of the feed lever.

The attachment can be seen in the photograph, Fig. 3, where it is indicated by the letter *H*, and a sectional view of the component parts in position is reproduced in Fig. 7.

To obtain a purchase for the inner end of the spring, an extension shaft is fitted concentrically in the pinion spindle, as illustrated in Fig. 8.

The next step is to make the pinion tunnel parallel throughout its length to enable the spring box register, shown at *A*, Fig. 7, to fit in place.

As the headstock casting is too large for mounting in a small lathe, this work may have to be carried out solely with hand tools in the following manner. The bore diameter is first marked-out and then filed nearly to size ; after this the bore is made parallel and to the finished size by means of a D-bit.

The D-bit can quite well be made of mild-steel, if it is case-hardened after it has been turned to fit the pinion tunnel and the cutting edges have been filed to shape.

To operate the tool, a lathe carrier attached to the shank is turned by hand, while sufficient pressure is maintained to ensure free cutting and to prevent the tool merely rubbing against the work.

The machining of the components, whose dimensions are fully set out in the working drawings in Fig. 9, is a straightforward exercise in lathe turning and no difficulties should be encountered. For the sake of appearance, the parts are best made of mild-steel, but bronze or duralumin can be used, provided that the bearing for the pinion shaft is well fitted and will withstand ordinary wear.

A small grub-screw is fitted to the outer diameter of the spring box cover to retain it in place and to enable the cover to wind up the spring as it is turned.

A discarded clock spring can be used for the operating spring, and it was found that one of 25-gauge and $\frac{5}{16}$ in. in width gave very satisfactory working. The inner end of the spring is bent to a right-angle to engage the cross-slot in the spindle, and the outer end is formed

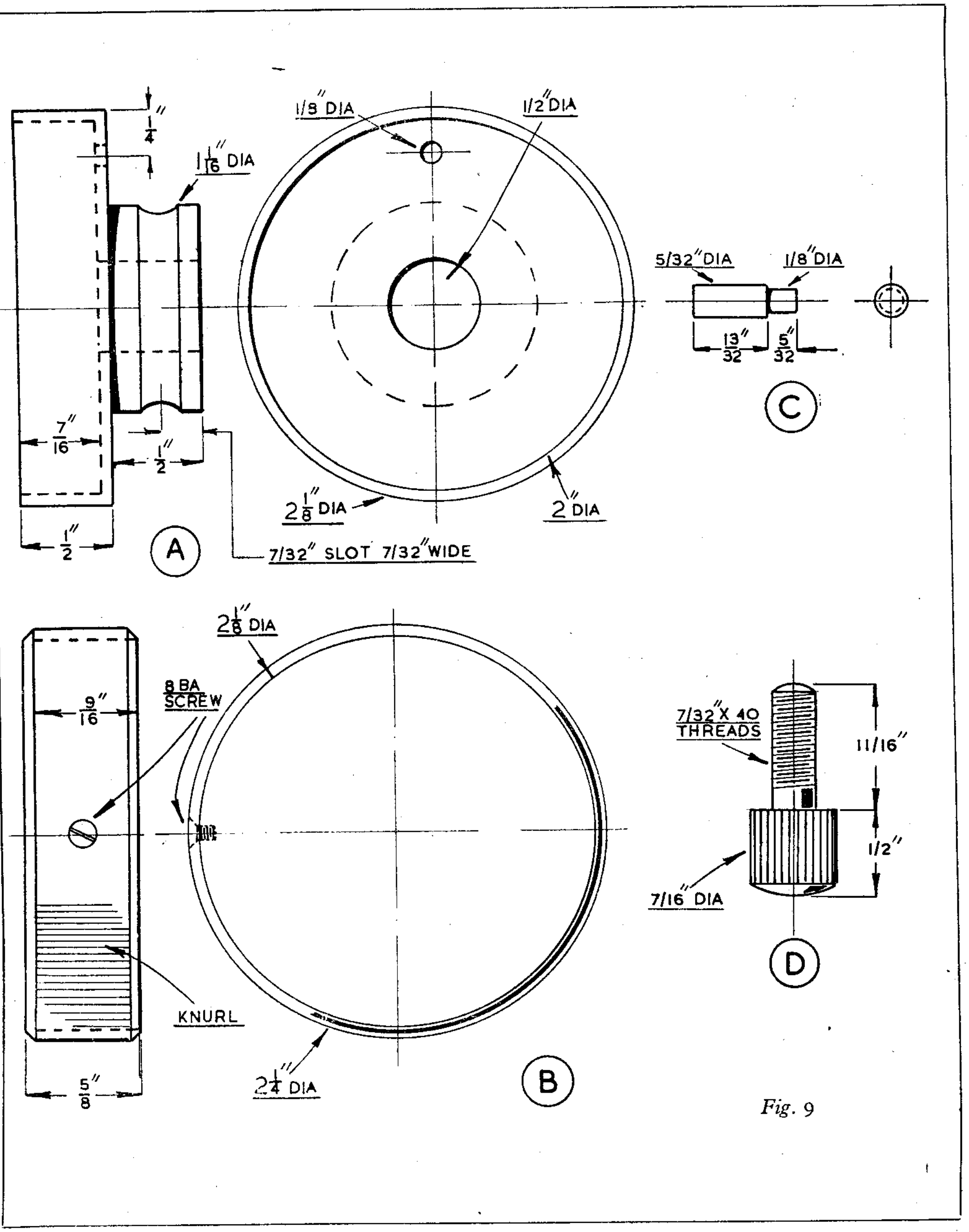


Fig. 9

with the round-nosed pliers to embrace the stud fitted to the spring box itself.

When the parts have been assembled on the drilling machine, the spring box cover is rotated until the necessary spring tension to raise the machine spindle has been obtained; the spring box is then secured in this position by tightening the locking-screw.

(*To be continued*)

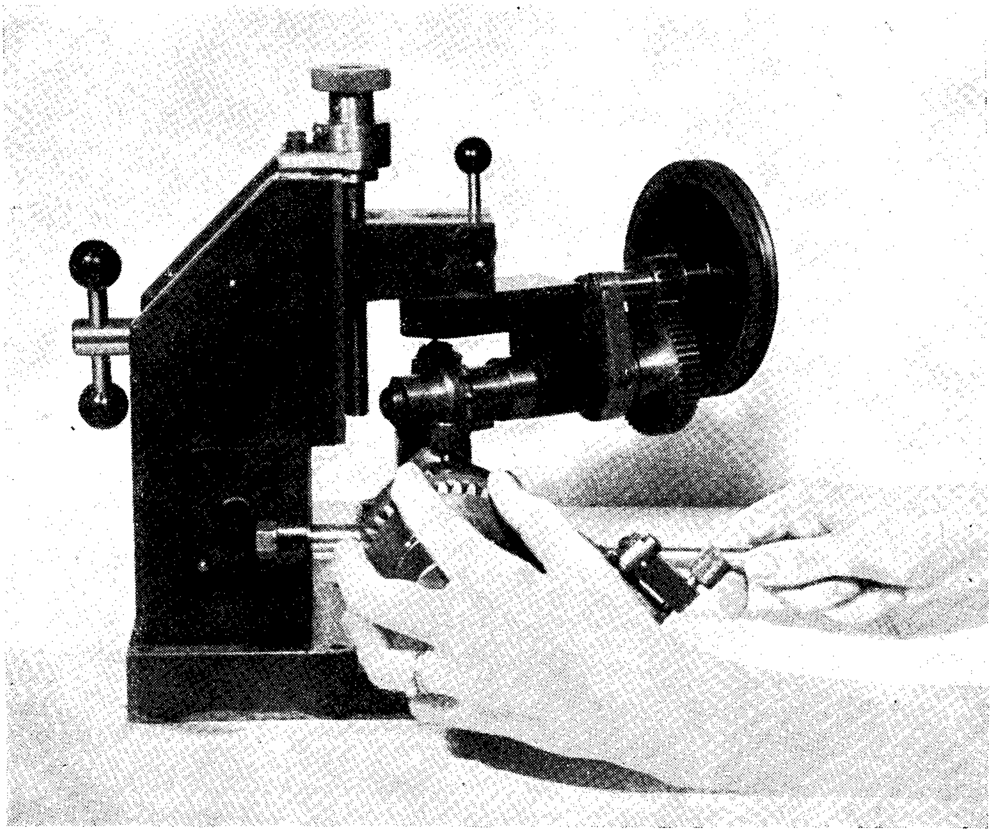
Power Tools from R.A.F. Motors

Mr. C. Law writes :—" Further to my letter in THE MODEL ENGINEER of March 24th in regard to my article on the above subject, I have now found a source of supply for these motors, and if interested readers will apply to J. Milligan, 24, Harford Street, Liverpool, 3, Lancs, they can obtain them complete at a special price of 15s., plus 1s. 6d. postage, until April 30th."

* Constructing a Gear-Cutting Machine

by J. S. Eley

THE under side of the base should first be machined up either by fly-cutting or surfacing in a lathe with the casting bolted to the face-plate. It is then reversed and the upper surface dealt with in the same way. The "V" ways must now be formed. The skin should first be taken off horizontal position however, the casting will have to be bolted in a vertical position by means of an angle plate. Four holes are drilled in the positions shown for bolting down the machine. Four $\frac{1}{8}$-in. Whitworth tap holes are also drilled in the front edge of the base for adjusting screws.



Method of handling when cutting spirals

the casting with the type " A " or " B " cutter and then the 60 deg. undercut formed with the type " D " cutter, both sides of the seating being finished at one setting. It is a good plan to make two of these 60 deg. cutters and use one for roughing only, the point being well rounded off. These end milling operations are best carried out on a milling machine with a vertical milling attachment in which case the work can be bolted flat on to the table. If the cutter is used in a

*Continued from page 442, " M.E.," April 14, 1949.

Table. C.I.

The machine table is machined up in exactly the same way as the base. In order to facilitate the fitting together of the two parts of the slide it is worth while making up two sheet-metal gauges, as per sketch, one for the internal and the other for the external portion. At this stage the gib or packing strip can be made up from standard mild steel strip and if the gauges are made to fit, the thickness of this strip and the subsequent machining operations carried out carefully to the gauges, a minimum of fitting will eventually be

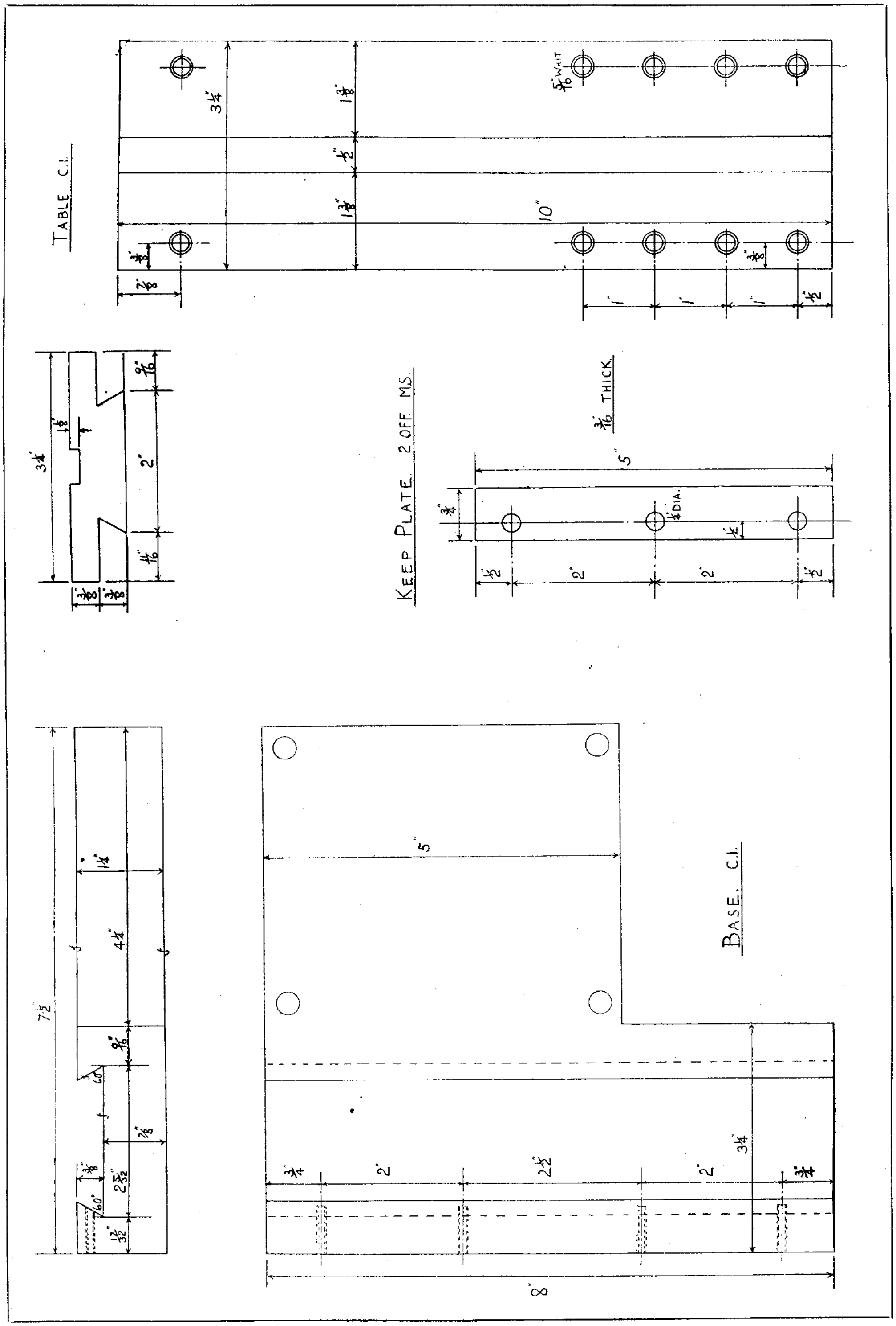
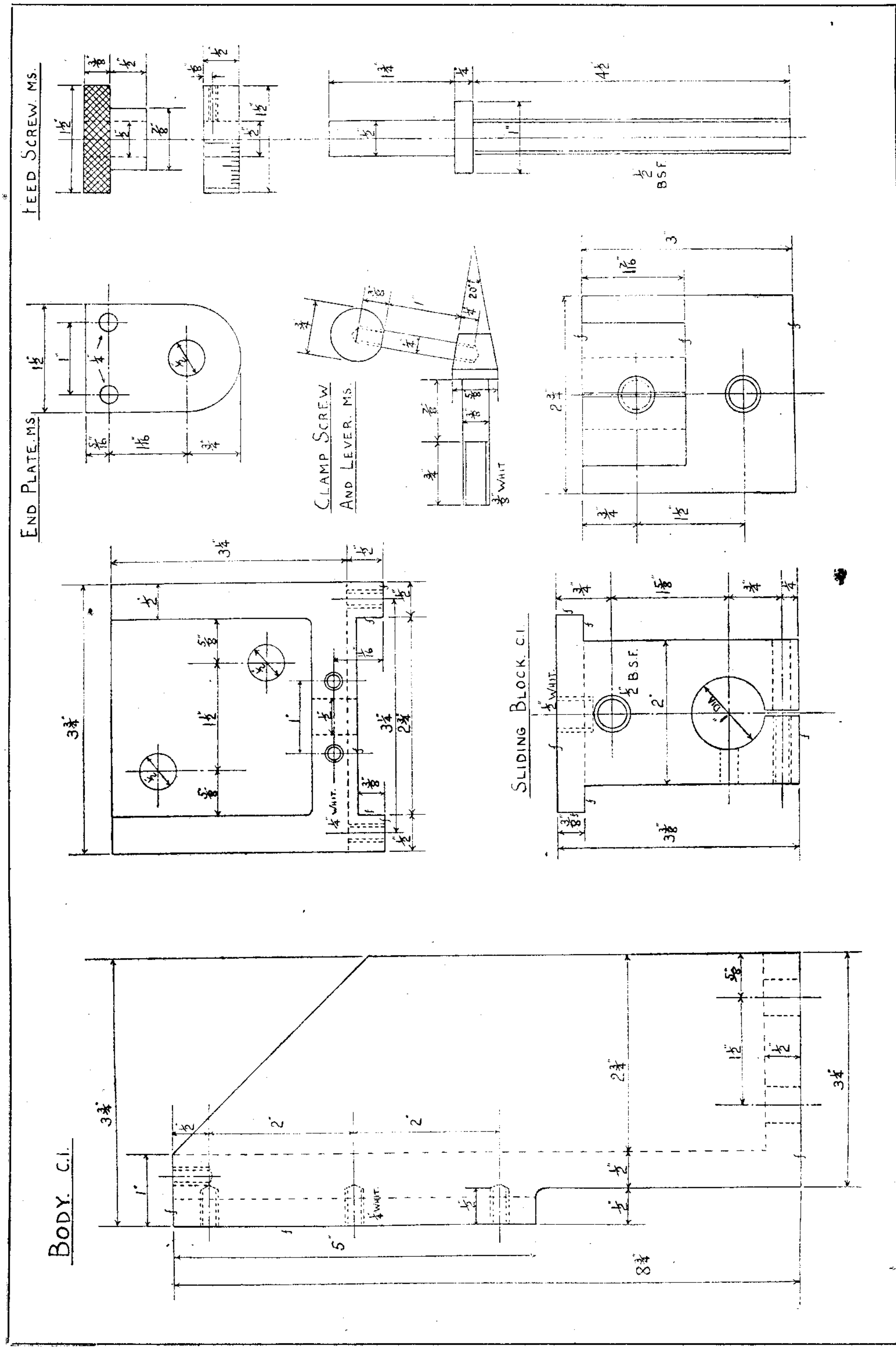
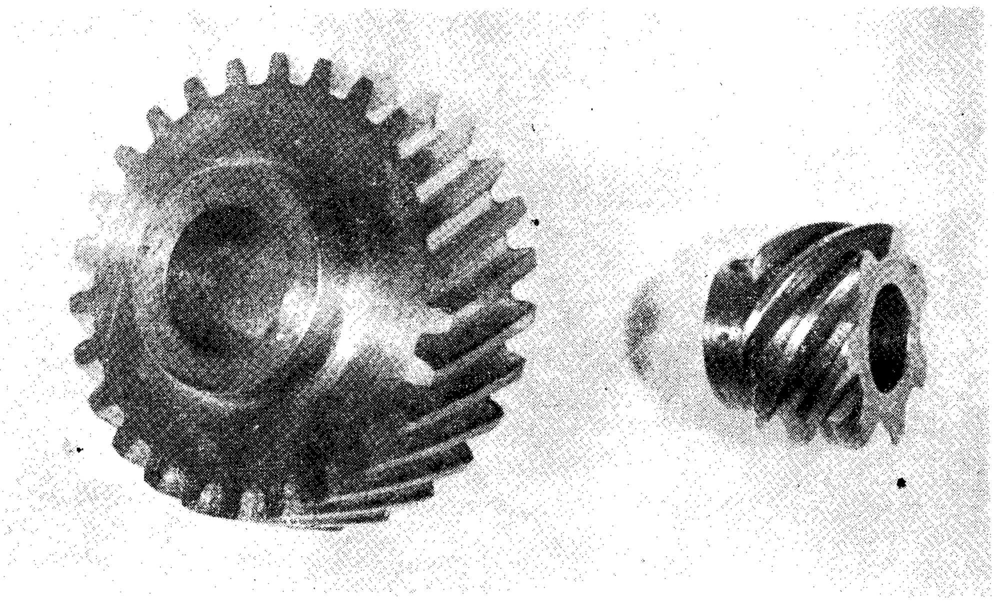


TABLE C.I.
KEEP PLATE 2 OFF M.S.
3/16" THICK
5/16" WHIT
1/4" DIA.
BASE. C.I.
10"
3 1/4"
1 3/8"
1/2"
7/8"
3/8"
1"
5"
2"
9/16"
11/16"
1/8"
3/4"
1/4"
7 1/2"
1 1/4"
4 1/4"
25/32"
17/32"
60°
2 1/2"
8"


FEED SCREW. M.S.
END PLATE. M.S.
CLAMP SCREW
AND LEVER. M.S.
SLIDING BLOCK. C.I.
BODY. C.I.

necessary. After the slides have been formed by end-milling with the 60 deg. cutter as previously described, the table is turned over for the end-milling of a shallow ½-in. groove down the centre. This groove receives tongues on both dividing head and back centre and keeps them in alignment. This can be done with the usual type of two-faced end-mill made from ½-in. silver-steel. vertical adjustments may be clamped tight when taking a cut. This having been done, the casting is now clamped down squarely across the machine table on the surface just machined and the base faced up. The casting is now reversed and the upper surface machined in the same way. Two ½-in. holes drilled in the base where shown complete the work on this part for the time being.



A pair of spiral gears produced for " 1831 "

Care should be taken to keep this groove parallel to the slides on the underside of the table. The front edge of the table must be machined to take the rack by means of which the feed is applied. The machining of the other three sides of the table is not essential but worth while on the score of appearance. It will be seen that there are several tap holes for holding down the dividing head and back centre but these are best left to a later stage when they can be spotted through from the parts in question. After fitting the slides together, the packing strip is dimpled by passing a drill through the adjusting screw tap holes in the base.

Body. C.I.

The casting forming the main body of the machine is of box form with a vertical slideway. This portion should be machined first and for this purpose it can be conveniently clamped down on its side on the milling machine table. With the tungsten carbide cutter gripped in a chuck on the mandrel nose of the machine, the skin is first taken off and then finished to size with a high speed steel cutter. This is a plain channel type slide and is formed by means of the square corner type " C " cutter. At the same setting the ½-in. vertical slot in the centre of the slide should be machined out by end-milling. This slot is to clear a ½-in. Whitworth bolt by means of which the whole of that part of the machine having

Sliding Block. C.I.

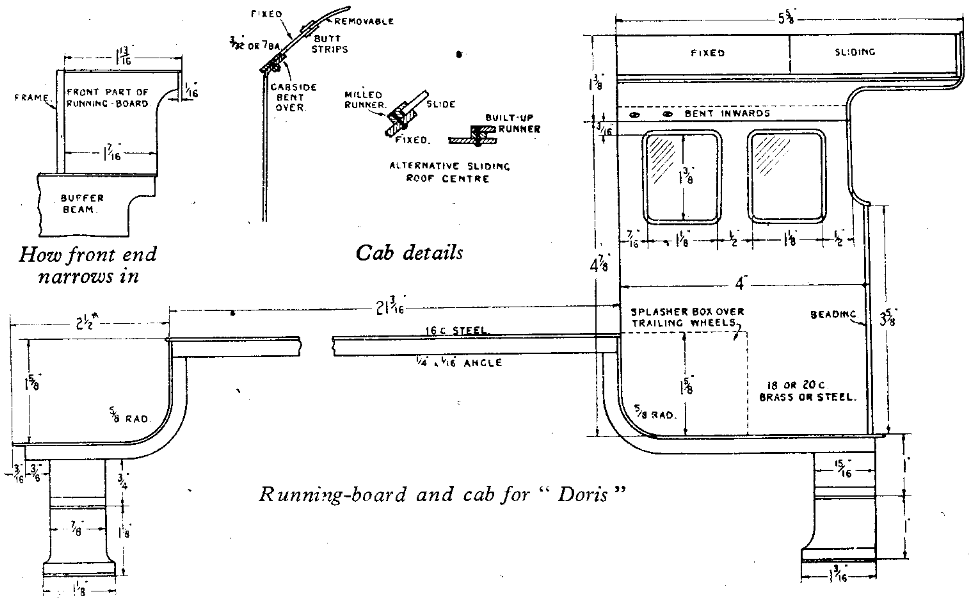
This block slides in the ways on the body casting and carries the cutter unit, consisting of the swinging arm, cutter spindle, reduction gears and driving pulley. I think the best way of tackling this is to mark out on the upper surface, the position of the 1 in. diameter hole. The casting is now held in the four-jaw chuck and centred for boring out the hole. Care should be taken over this bore as it must be a close fit over the spigot on the swinging arm. After boring, the upper surface of the casting is faced off at the same setting. After marking off the position of the ½-in. B.S.F. tap hole and slide surfaces on the newly machined surface, the casting is clamped to an angle bracket by means of a bolt through the 1-in. diameter hole and the slide surfaces machined all over by end-milling. The inner edges of the slide tongues can be machined at the same setting by means of a Woodruff type cutter, but it will be found more convenient to unbolt the casting and clamp it down on its back on the machine table to mill these surfaces. The front edge of the block must now be split and the neatest way is to run a $\frac{1}{16}$ in. circular slitting saw right through into the bore. Tapping and clearance holes for the clamping bolt are now drilled where indicated and the ½-in. B.S.F. tap hole for the feedscrew can also be drilled and tapped. One more surface must be machined—

(*Continued on page* 492)

A $3\frac{1}{2}$-in. Gauge L.M.S. Class 5 Loco.

by "L.B.S.C."

THE running-boards on the little L.M.S. engine are made up in a manner somewhat similar to those of the "Maid of Kent," so there is no need to go into full details. The best way is to make them in three pieces, joined same way as suggested for the "Maid"; but there is one difference. The "Maid's" are the same width full length; "Doris's" are not, owing to the buffer-beam being shorter than the drag-beam. Either 16- or 18-gauge steel, or brass if preferred, may be used, the width bending angle is to solder a piece of square rod in the angle, bend the lot, and then melt out the square rod, leaving the angle bent as required, without kinks; a very good wheeze too, as I found when bending the angle stiffeners for the cab tops of "Jeanie Deans" and "Grosvenor." Incidentally, I made these weeny angles by milling out bits of $\frac{1}{8}$-in. square rod; another Winter specification which proved "the berries," as the resulting angle was cleaner and thinner than the drawn or extruded variety,



How front end narrows in

Cab details

Running-board and cab for "Doris"

of the strip being $1\frac{13}{16}$ in. The curved section ahead of the cylinders needs a piece approximately $3\frac{7}{8}$ in. long. Cut this to the shape shown in the plan view, the front edge being $1\frac{7}{16}$ in. long, curving out to the full width just below the valance on the "high-level" running-board; the end view is shown in the detail illustration. The long straight section, being above the coupled wheels, requires no wheel clearances cut in it, but the left-hand side will need clearance for the reverse-rod and the injector delivery pipe; these can be obtained from the actual engine, far easier than by description and drawing. The curved section at the trailing end is made the same way as that at the front end, but it is the same width all along.

The straight runs of the valances are made from $\frac{1}{4}$-in. by $\frac{1}{16}$-in. angle, riveted to the underside of the running-board by $\frac{1}{16}$-in. rivets, preferably charcoal iron, if steel running-boards are used. The valances should be approximately $\frac{1}{16}$ in. from the edge. If you can bend angle, which isn't difficult, the whole length can be made from it. Dr. J. B. Winter's dodge for and would bring joy to the heart of Inspector Meticulous. If you find that you can't bend angle without kinking it, cut the curved parts of the valances from 16- or 18-gauge sheet, and join them to the straight parts with a butt-strip at the back, same as illustrated for the "Maid." The steps can be fabricated from 16- or 18-gauge sheet steel, same as "Maid" and "Minx," and attached to the running-boards as described for those engines; both dimensions and positions are given in the reproduced drawing. The complete running-boards are attached to the tops of front and rear beams by a couple of countersunk screws in each, 6-B.A. being plenty big enough. They receive support from the guide-yokes or motion-brackets, and the link girders; and sheet-metal brackets, as described for "Maid" and "Minx," can also be used to support them between the driving and trailing axles, and ahead of the cylinders. Making and fitting the brackets is a simple job requiring no detailing. Cast brackets may, of course, be used if desired, but "fabrication" is "all the go" nowadays!

Cab

The front of the cab was shown with the illustration of the backhead fittings; the sides are shown here. They are made from 18- or 20-gauge sheet brass or steel, just as you prefer, and the hints given for "Maid" and "Minx" apply equally to "Doris." All necessary dimensions are given in the illustration. I would strongly advise beginners to cut out a stiff paper or cardboard template first, to the given sizes, and take very great pains to have the curved front bottom edge an exact fit in the curve of the running-board. When you get your template or pattern O.K., cut your piece of metal exactly to the same shape and size, and you don't waste any.

When cutting out the sides, leave a strip about $\frac{3}{8}$ in. wide along the top, over and above the height of the side ($4\frac{7}{8}$ in.) and bend this to line up with the top edge of the cab front. Pieces of angle are needed at the bottom and front edges, to attach the cabside both to the cab front and the running-board; these angles can be of the same kind used for the valances. The windows are fitted same as the "Maid," and edged with $\frac{1}{16}$-in. half-round wire, which is also used for the beading at the back of the cab, and around the edge of the cab roof. It can be soldered to a steel cab, if the metal is cleaned quite bright, and a good liquid flux is used; but wash all the flux off with hot water, after the soldering job is finished, to prevent rusting.

The roof of the cab is made from a sheet of the same metal as used for front and sides, measuring approximately $5\frac{5}{8}$ in. by $7\frac{1}{2}$ in. The corners of this are cut away and radiused off, as shown in the sketch of the roof in the flat. Owing to the overhang which protects the fireman in bad weather (rather different from the Webb cab roofs!) the centre part must be made either completely removable, or arranged to slide forward, like a kind of "sunshine roof." Both methods are shown. To make the back part completely detachable, simply cut out a piece of the roof, as shown; the exact size of this depends on yourself, how much room you need to get at the handles. A thin butt-strip is riveted at top and bottom, at each side, overlapping the edge of the opening; and a piece of metal, same gauge as the cab top, is cut to slide between the open edges of the butt-strips, as shown in the detail illustration. When the engine is in use, this piece is pulled completely out.

For the "sunshine roof" stunt, which I have used on "Tugboat Annie" and "Cock-o'-the-North," the piece is cut out as before; but a little runner is fitted, either by riveting or soldering, at each side of it. This extends to the front edge of the roof. A piece of sheet metal, same gauge as cab roof, is cut, bent to the curve of the roof, and slid between the runners. When the engine is in service, the piece is pushed right up forward, level with the cab front, leaving the gap open. When the engine is out of service, it is pulled back, level with the back edge of the roof, and covers the opening. The runners can be made either by milling a rebate in a piece of $\frac{3}{16}$-in. by 3/32-in. strip, or using two strips, one wide and one narrow, as shown. I used the milled runners on my own locomotives.

The completed roof is attached to the bent-over portions of the cab sides, by 3/32-in. or 7-B.A. countersunk screws, nutted under the roof as shown in the detail sketch. A rectangular box, of the same kind of metal as the cab, is made and fitted to the inside of the cab on each side, to cover the wheels, as in full-size practice; this can be permanently soldered, or attached by pieces of angle, to the inside of the cab. Make-up pieces of the same kind of steel used for the running-boards, are fitted between the frames ahead of the smokebox, and behind the backhead. The latter piece may be attached to the top of the drag-beam by a couple of 3/32-in. or 7-B.A. countersunk screws; but the front piece must be detachable, for getting at the lubricator. On "Jeannie Deans" I used two 3/32-in. steel pegs, riveted into the piece of plate, and fitting in corresponding holes in the top of the buffer-beam. This did the trick in fine style, rendering the piece instantly detachable; but at the same time the pegs prevented it shifting or jumping out when the engine was running. On the full-size "Jeanie" there was nothing at all between the frames, between buffer-beam and l.p. cylinder cover, but I didn't like the wide open space on the little one, so I covered it over as above, and it looks all right.

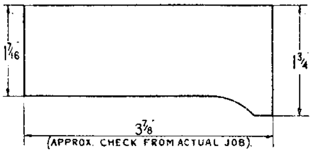
"Doris" in 5-in. Gauge

Before proceeding with the rest of the "trimmings," brake gear, and tender, I had better reply collectively to a number of letters which have come to hand regarding the possibility of building a 5-in. gauge "Doris." First of all, I don't want to throw cold water on the idea—don't get running away with that notion for one minute; but I earnestly ask everybody who has written, or who contemplates the idea of building "Doris" (or any other locomotive, if it comes to that) in 5-in. gauge, to consider very carefully whether their equipment will be adequate for the job; how much they can afford to spend on it; and whether they realise how long it is likely to take, and the size and weight of the engine when completed. It is a jolly good "two-man" job to lift the engine alone; and even when building, after you have got the frames erected, and the cylinders and wheels on, it needs a pretty strong person to move it about or turn it over on the bench. I am constrained to call attention to these points, by virtue of letters received from builders of the "Maid of Kent," who light-heartedly started on the job, hit their first lot of trouble in machining the big driving wheels and the cylinder-block on a lathe of 3 in. centre or thereabouts, became alarmed at the size and weight of the chassis as it "grew up," and are now getting worried about the boiler. Many correspondents who asked me to describe a 5-in. gauge engine, wanted a 4-6-0 or "Pacific" (three correspondents at least, asked for the four-cylinder L.M.S. "Sir William Stanier") and nobody at all suggested a small shunting tank of the 0-4-0 or 0-6-0 varieties. I had a "hunch" what was going to happen, having built so many locomotives myself; so I selected the two simplest and smallest tender engines of normal type, the 4-4-0 and 0-6-0. Builders of these engines are, as stated, finding the job just as much as they can

manage; there are, I might add, far more "Minxes" being built, than "Maids." Well, with that preliminary warning, here are a few remarks on a 5-in. gauge "Doris" for those who have the equipment, energy, and cash to tackle it.

Existing Drawings Can be Used

The measurements shown on the drawings published in these notes, or the blueprints sold by our advertisers, can be increased in the proportion of 7 to 10 for all general dimensions, such as wheel centres, length of frames, pin centres of valve-gear and so on. Variations may be



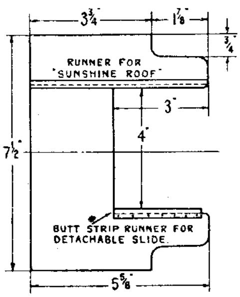
Front part of running-board "in the flat"

made where desirable, to bring the engine more into line with full-size practice; for instance, the cross-section of connecting- and coupling-rods, valve-gear parts and so on, may be a little lighter in proportion. Frames *may* be made from 1/8-in. steel, as specified for "Maid" and "Minx," but it would be better if they were a little thicker, the distance over the outsides being 4 5/8 in. Horns and axleboxes same as "Maid." The bogie can also be the same as "Maid," or the specified 3 1/2-in. gauge bogie enlarged; but if this is done, I should advise a proper inverted leaf spring each side, as in full-size practice, instead of the plunger-spring arrangement. The front end of a 5-in. gauge "Doris" is going to be mighty heavy! The bogie wheels would be 3 1/2 in. diameter, and the coupled wheels 6 5/8 in. diameter.

The cylinders should be 1 11/16 in. bore by 2 1/2 in. stroke, with 7/8-in. piston valves; these may either be of the plain bobbin type, in which case several fine grooves might be turned in each one, to hold the thick cylinder oil and form a seal (called "labyrinth packing" in full-size practice) or proper rings may be fitted. Cast-iron should not be used for cylinders unless the engine will be running very frequently; despite all that has been said and written, I have never yet come across a case of cast-iron cylinders that did not deteriorate through rust and pitting, when the engine was out of use for any length of time. A variation could be made with advantage, in this size, for getting rid of the exhaust steam; if sufficient readers are interested, I would gladly give a drawing of my recommended ports, valves, etc., for a 5-in. gauge "Doris," by kind permission of our friend the K.B.P., but it isn't worth doing it "on spec." It is as much as I can do, to get out the drawings for the "serial" engines. Incidentally, it is a wonder you got anything at all, these last three weeks or so; my fair lady caught the flu among the Saturday shoppers and passed it on to me. It is the first time I have been "laid out" since the bad air on the "Underground" did it, many years ago. Like "Sophie Tuckshop" on the radio, "I'm all right now" except for a sore throat which makes talking very painful. If this meets the eye of Mr. Clarkson, of New Zealand, he will know why he didn't get the promised telephone message whilst staying at Sydenham. Returning to the job, the valve-gear will be all right if the 3 1/2-in. gauge instructions are followed, enlarging the parts as stated.

Boiler

The shell of the boiler should be made of 1/8-in. copper with 5/32-in. backhead, the dimensions of both barrel and wrapper being enlarged as above; but the inside firebox, tubes, superheater flues, and so on, should be made the same as I described for the 5-in. gauge "Swindon Kettle" in these notes some time ago. Blueprints of this boiler, full size for a 5-in. gauge engine, are available. It will make all the steam needed, and supply it good and hot; by the way, I am pleased to see that high superheat, long-travel valves, big ports and mechanical lubrication, advocated in these notes for so many years, and specified for my own locomotive designs, are now being "boosted" by our more enterprising advertisers; good luck to them! It is high time all the old conventions were cast away for ever. The detailed instructions given for building the "Swindon Kettle" can be applied to the boiler of a 5-in. gauge "Doris," so I need not dilate further on that subject. The boiler fittings can be the same type as described for the "Maid" and "Minx." Concluding this very short summary, all the instructions given for machining and fitting the various components of the "Maid" and "Minx," apply equally to a 5-in. gauge edition of "Doris" and provided that the equipment is available, no particular trouble should be experienced in building it. However, don't forget that I warned you, it is a lengthy, hefty, and fairly expensive job, and rather too much for a beginner to tackle.



Cab roof before bending

Contrary to the above, some followers of these notes who own gauge "1" indoor railways, ask if it is feasible to build a little "Doris" to half the given dimensions, to suit their railway, and could it be fired by oil or spirit? The answer to this is definitely "yes"; but the best thing to do, regarding instructions, would be (if our friend with the blue pencil raises no objection) to devote one week to giving notes plus a few drawings for the job, same as I did with the gauge "1" "Juliet." Two or three sheets of blueprints could be made available. With an oil-fired water-tube boiler, the engine should make easy work of a train of eighteen or twenty coaches on an outdoor "scenic" line, and would have no difficulty in doing a spot of live passenger hauling. A gauge "1" "Dyak" type engine I built for a friend, now, alas! over the Great

Divide, hauled my weight easily, and ran away with a boy of 12.

How Experiences Differ

Three of my fleet of locomotives are provided with working donkey-pumps for auxiliary boiler feed. "Fernanda," a 2½-in. gauge 4-6-2, has a vertical single-cylinder pump of the Weir pattern. The trip rod operating the reversing-valve is worked off the piston-rod. The reversing-valve operates two small shuttle pistons on a single spindle which passes through a slot in the back of the main valve, a simple slide valve of the usual type, the ports being just plain drilled holes. The steam cylinder is $\frac{5}{16}$ in. bore and ⅜ in. stroke; the piston-rod is 7/32 in. diameter, and prolonged to form the pump ram. The pump cylinder is made the same shape as the steam cylinder; it is separated from it by a turned distance-piece, and the trip rod works between them. Both steam and water valves are at the side. This pump has been fully described and illustrated in these notes, and blueprints of it are available.

"Annabel" the 2-6-6-4 "Mallet," has a similar pump arranged horizontally. The valve-box on the water pump is located vertically across the end of the pump cylinder, otherwise the "works" are the same.

The 4-12-2 "Caterpillar" has a twin-cylinder duplex pump, made exactly as described for "Fayette," back in 1928 or thereabouts. The cylinders are $\frac{5}{16}$ in. bore, ⅜ in. stroke, the piston-rods being hollow, and containing trip rods similar to full-size Westinghouse pumps. These trip rods pass through weeny glands on the top cylinder covers, and operate the valve spindles direct by rockers. The ports are crossed, the steam-ways being all drilled in the casting.

Each of the above donkey-pumps is supplied with wet steam from a valve on the backhead of the boiler; both "Annabel" and the "Caterpillar" have several inches of exposed pipe between the steam valve and the pump cylinder. *Each pump is furnished with a little displacement lubricator on the steam pipe*, close to the pump. As the pumps work on wet steam, I do not use the heavy grade of superheater oil, as used in mechanical lubricators, for the pumps, but a more fluid oil, of about the same viscosity as used in the engine of my gasoline cart. The lubricators are always filled before getting up steam. The pumps will start all right when the steam valve is opened, but work erratically until they get rid of all the condensate water; when it has all been blown out, and the cylinders attain working temperature, the pumps work evenly, ticking away like sewing-machines, and maintaining a steady feed. By careful regulation of the steam valve, it is possible to keep a practically constant level in the gauge glass. Now, should one of these pumps quit work when the engine is running, *it is an unfailing sign that the lubricator is empty*, and I immediately stop and refill it, when the pump resumes "business as usual." I could, of course, force the pump to carry on, by giving it more steam, which would easily overcome the extra friction entailed by the failure of the oil supply; but no engine-driver in his right senses would ever force any part of his engine to run without oil! It is a standing joke, that a driver and his oil feeder are inseparable companions; but it happens to be a joke with a solid foundation of truth behind it!

I might add that "Fernanda's" pump worked for nearly thirteen years before the shuttle pistons became worn sufficiently to allow steam to pass and "stop the clock." Had I run it without oil, it wouldn't have lasted the proverbial five minutes. 'Nuff sed!

Constructing a Gear-Cutting Machine

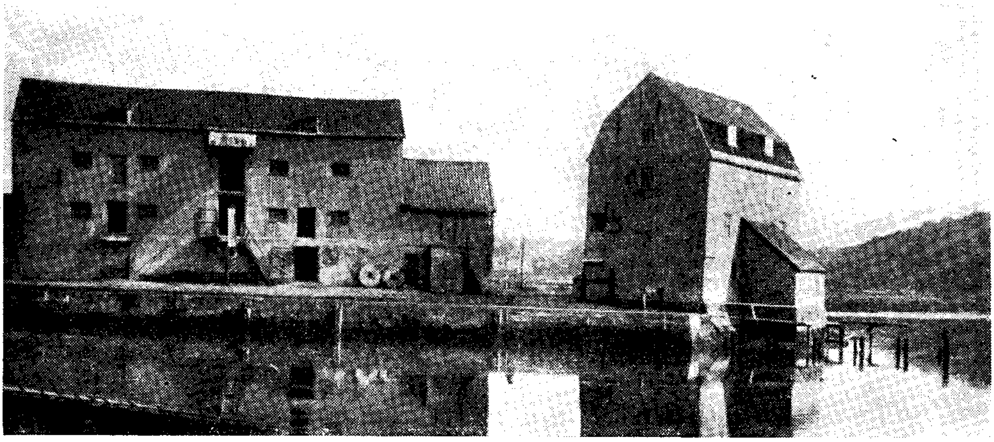
(*Continued from page* 488)

the underside of the bracket. This must be dead square with the bore, and seeing that this bore can now be tightened up, the block can be clamped round a 1-in. bar held truly in the lathe chuck for this facing operation. After the two ½-in. Whitworth tap holes in the back of the block have been drilled and tapped it is ready for fitting to the body casting. The two parts of the slide, which should have been machined a tight fit, are now made a sliding fit by careful scraping and when the keep-plates are screwed down tight, there should be no appreciable play. The keep-plates are merely 5 in. lengths of ¾ in. × $\frac{3}{16}$ in. B.D.M.S. drilled and countersunk where indicated. Their corresponding tap holes in the body castings are spotted through.

Feedscrew. M.S.

This is a straightforward turning and screw-cutting job and calls for no special comment, all the work being done between centres. The B.S.F. Whitworth form thread is quite satisfactory in use and I hardly think it necessary to go to the trouble of cutting square threads. The feedscrew keep-plate is made from 1½ in. × $\frac{5}{16}$ in. B.D.M.S. drilled ¼ in. clear in the positions marked. This is bolted to the top of the body casting by two Allen socket screws in corresponding tap holes. The screw is operated by a knurled knob turned from 1½ in. round steel bar. A taper pin secures this knob in position. For adjusting the depth of cut a graduated collar is fitted immediately under the operating knob. This is a plain steel collar free to revolve on the plain portion of the screw except when locked by the small ⅛-in. Whitworth knurled headed screw. The graduations can be engraved in the lathe by indexing with a change wheel on the end of the lathe mandrel and scribing with a pointed tool held sideways in the toolpost—an operation often described in these pages. Alternatively, this job can be left till later and done on the machine itself, an operation which will be described fully at a later stage. As the B.S.F. thread is $\frac{1}{16}$ in. pitch, the collar is divided into 62 divisions, each representing 1/1,000 in. of feed.

(*To be continued*)



Woodbridge, Suffolk. The tide mill is the building to the right, the wheelhouse being at the far end out of sight. The mill is covered with white-painted corrugated iron and the roof is of red pantiles. The building to the left houses the power-driven machinery

SOME NOTES ON TIDE MILLS

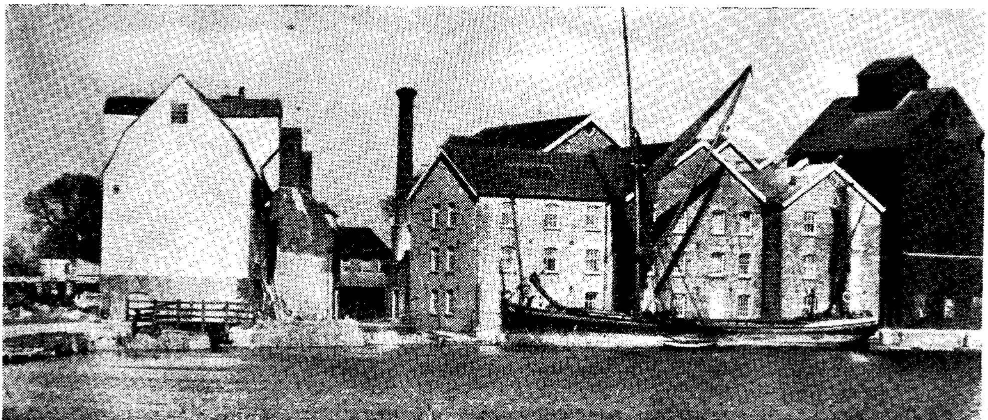
by Rex Wailes, F.S.A., M.I.Mech.E.

THE use of tidal power is not new. In Domesday there is a reference to what appears to have been a tide mill in Dover " which carries disaster to vessels by the great disturbance of the sea . . . it was not here in the time of King Edward." There are also 12th century references to sites still occupied by tide mills at Woodbridge in Suffolk and Bromley-by-Bow, in London.

A tide mill may be defined as one which makes use of tidal water as a source of power. Some mills use tide water only, impounding it in a pond, which may vary in extent from 7 to 30 acres, and is enclosed by an embankment in an estuary. Others may use a proportion of fresh water also, with a dam across a river mouth, the water backing up for as much as a mile upstream.

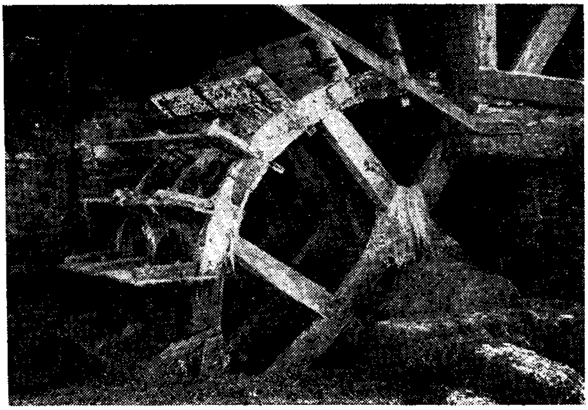
Two types of automatic sluices are used. The most common resembles lock gates and opens automatically when the tide rises above the level of the water in the pond, closing when the tide ebbs. The impounded water is used to drive the mill. The other type of sluice resembles the flap-valve used for sewer outfalls, and the cycle of operations is the same.

Ten years ago the following mills were still worked by tidal power :—Essex, Stambridge ; Hampshire, Beaulieu and Eling ; Isle of Wight,



Stambridge, Essex. The illustration shows the white-painted weather-boarded mill to the left, with the red brick millhouse behind it. The modern power mill is to the right with a sailing barge in front of it

East Medina Mill at Whippingham, and Wooton; London, Three Mills at Bromley-by-Bow; Pembrokeshire, Carew and Pembroke; Suffolk, Woodbridge; Sussex, Slipper Mill at Emsworth.



Birdham, Sussex. This outside wheel was of "clasp arm" construction, entirely of oak and mounted on an 18 in. oak shaft. It was 11 ft. 6 in. diameter × 7 ft. wide, with 24 straight floats

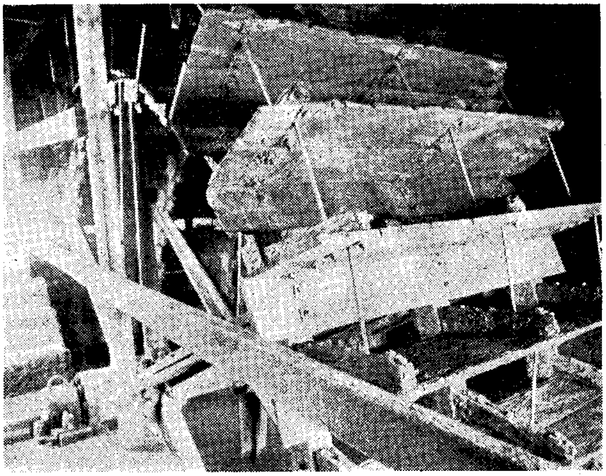
In addition, three mills, though out of use, were complete as to machinery, two in Essex, at St. Osyth and Thorrington, and one in the Isle of Wight, at St. Helens.

With the exception of Woodbridge, all these mills are now out of use so far as tidal power is concerned.

The water wheels are seldom visible from the outside, Thorrington and St. Helens mills being exceptions. Most of the wheels are located inside the mill, though at East Medina and Woodbridge mills, each is at the end of the mill building in a small wheelhouse of its own. Wheels are breast shot when the pond is full and almost undershot when it is nearly empty. Straight and poncelot floats are used as well as buckets, and the construction is of wood, or iron, or both. The most powerful was the iron wheel with wood buckets, at Pembroke Mill, which was 20 ft. diameter by 12 ft. wide, and drove four pairs of stones and a 30 h.p. dynamo with a 12-ft. head of water. It would have to deliver about 70 h.p. to do this.

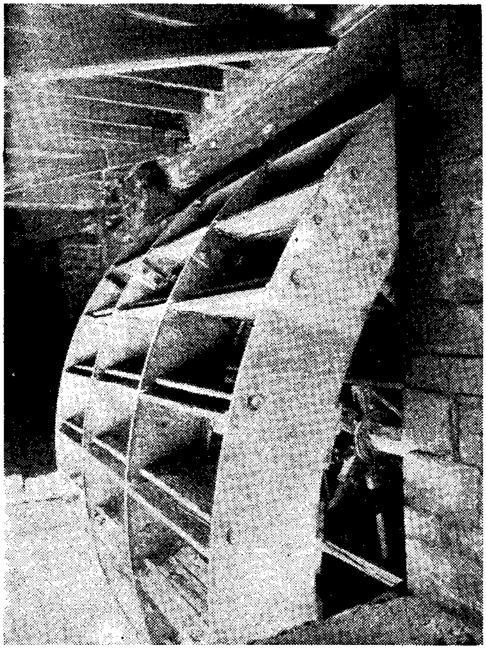
The methods of construction of these wheels are of interest. The earliest type is known as the "compass arm" wheel and is that in which the spokes are morticed through the wooden wheel shaft. The smallest wheel encountered was of that type at Beaulieu Mill. It was 12 ft. 4 in. diameter by 4 ft. 6 in. wide, and was mounted on an 18 in. diameter wooden wheel shaft. This method of construction weakens the shaft at the point where the drive is taken and hence where most strength is needed. An improvement on this was to arrange four arms like a double cross to form a hollow square at the centre through which the wheel shaft passed. It is known as the "clasp arm" wheel and is of extremely strong construction. The largest one is at Wooton Mill, about 24 ft. diameter by 6 ft. wide, and the smallest at Slipper Mill, Emsworth, 9 ft. diameter by 8 ft. 6 in. wide. The use of cast-iron in millwork dates from the second quarter of the 18th century and the wood and iron wheel at Pembroke mill has already been mentioned. Wheels entirely of iron were seen at Eling, where they were about 11 ft. 6 in. diameter and 5 ft. 3 in. wide, and at Three Mills, Bromley-by-Bow, where the seven wheels are between 19 ft. and 20 ft. diameter, and between 3 ft. and 8 ft. wide, delivering a maximum of 225 h.p. between them.

It will be obvious that tide mills can only work for two periods every 24 hours. The acutal working time depends on the state of the tide and the situation of the mill, the maximum being about seven hours per period. As the tide varies in time regularly each day the millers working times have to vary in corresponding manner. Under modern conditions the tide is only used to maximum advantage where shift working is in force and an alternative source of power available. These conditions were met with at Three Mills, Bromley-by-Bow, which incidentally, is a distillery and, therefore, not available for inspection.



East Medina Mill, Whippingham, Isle of Wight. This wheel is housed in a wheelhouse at one end of the mill. It is of iron with 30 oak floats and starts, and is 15 ft. 6 in. diameter × 6 ft. 8 in. wide. It is mounted on a 12 in. octagonal oak shaft

In the past, there have been nine or more tide mills on the Thames or its tributaries in the London area. Those known were:—Three Mills, Bromley-by-Bow; The Old Flood Mill,

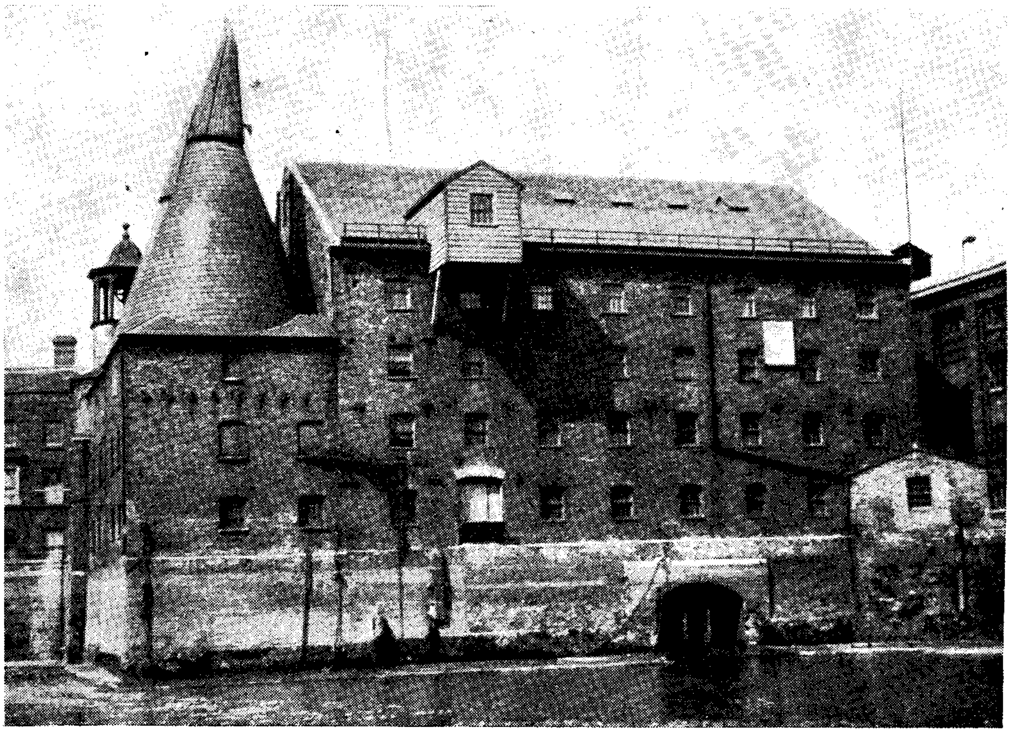


Deptford, on the Ravensbourne ; East Greenwich ; Hackney Marsh ; Horsley Down ; Kings Mill, below the Thames Tunnel ; London Bridge ; Nine Elms ; Rotherhithe, and Savory Mill, Southwark.

London Bridge Mill was the most famous, having been built in 1580, with floating wheels in the arches of the bridge and used for pumping water for domestic supply. By the 18th century it had four wheels 20 ft. diameter by 14 ft. wide, driving 20 double and 32 single-acting pumps and delivering 123,120 gallons per hour with a 20 per cent. leakage loss.

Tide mill buildings are, generally speaking, very attractive and vary in style according to their locality. On the East Coast white painted weather-boarding or red brick is favoured. Brick is now almost universal on the South Coast, and stone on the West Coast. The machinery and gearing follows usual watermill practice and some fine examples of the mill-wrights' art are to be seen. For further information the reader is referred to the *Journal of the Junior Institution of Engineers*, for January, 1941.

Pembroke. This wheel is housed below the mill and is of iron construction built up in three sections, only the buckets being of wood. It is 20 ft. diameter × 12 ft. wide and mounted on an iron shaft 9 in. square



Bromley-by-Bow, London. Although known as Three Mills, only two mills remain, the third having been demolished in the reign of Edward VI. The illustration shows Clock Mill which gets its name from the clock tower in the background, to the left of the malt kiln. The mill contains three wheels of 20 ft. diameter, and was rebuilt in 1817